No. [redacted]165.

In the Supreme Court of the United States

OCTOBER TERM 1923.

THE JOHN E. THROPP'S SONS' COMPANY
Defendant-Appellant,

VS.

FRANK A. SEIBERLING.
Plaintiff-Appellee.

BRIEF—AMICUS CURIAE.

HARRY FREASE,
Canton, Ohio,
Amicus Curiae.

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A careful reading of the transcript and a consideration of the exhibits impresses one with a feeling that the issues involved can be readily resolved by a review of the fundamental defense of anticipation, and the less fundamental defense of no invention over the state of the art; and with a belief that such a review will naturally solve the other defenses which have been presented by the record, and which will no doubt be discussed more or less by Counsel for the respective parties to the suit.

The fundamental defenses referred to are based upon the alleged prior use and general knowledge of the method or process which may be carried out by a machine embodying the disclosure of the State patent in suit; and upon the existence of sundry prior patents, especially the Mathern Belgian patent, which are alleged to disclose machines containing the same combinations of parts which are included in the claims in suit of the State patent, by which automobile tires have been or can be built by the same mode of operation which is said to be inherent therein.

In any art, the knowledge, or at least the perception, of a process or method must necessarily precede the conception and development of a machine or apparatus for carrying out the process; and as in the present instance the history of the immediate art shown by the record seems to have followed this natural course, it will be more convenient to consider First, the method or process of building tires for which the State machine may be used; and Second, the prior patents which may anticipate the claims of the State patent as the same stand subject to the disclaimer of record.

PRIOR PRACTICE.

The defense of prior knowledge and general use of the method or process which may be employed for building tires by the machine of the State patent, is based primarily upon the testimony of numerous witnesses to the effect that automobile tires were previously built on rapidly rotating cores by means of spinning wheels manually applied, in the same manner that such tires are built upon the State machine.

William W. Duncan of Watertown, Mass., president of The Hood Tire Company engaged in selling automobile tires made by The Hood Rubber Company since 1914, who is also manager of the tire department of the manufacturing company, which began making tires by hand in the spring of 1906 and continuously made them by hand from 1906 to 1911 (I-191, 2)*; described how the fabric was placed on the core, as follows:

> "The core was mounted upon what was termed the spider, this spider consisting of a hub with three radial arms. Upon one of the arms was attached a handle for the purpose of rotating the spider and

* Reference to the Transcript of Record.

core. The hub was bored to fit upon a projection of the supporting arm *upon which it would revolve.** This supporting arm was curved in such a way as to miss hitting the core by about four to six inches, and then curved back into the line of the plane of the core, continuing in the line over the top of a bench. It was held on the top of the bench by two clamps one of which contained a set screw, so that the core and spider could be held either in a vertical or a horizontal position, or any position between, by clamping or unclamping the set screw.

"For applying the fabric to the core, the core was placed in vertical position; a piece of fabric was furnished the operator of proper width to cover the core from side to side and approximately *twelve per cent less in length* than the circumferential measure of the top of the core. I have omitted to mention that on the hub of the spider was a pawl attachment whereby the pawl engaging with the hub could hold the core fixed in one position" (I-192).

"The operator took one end of the fabric in his hands, throwing the balance of length over his shoulder. He cemented a small spot on the top of the core and attached the end of the fabric to this spot. He then *stretched the fabric* from that spot onto about eighteen inches of core circumference. Then moved the position of the core so that the point of contact with the fabric was again at the top position, setting the pawl to hold it again in that position, and again stretched the fabric another twelve to eighteen inches of the circumference. He continued the stretching operation until the piece of fabric covered the entire circumference at the top of the core section, and lapped the end of the fabric about one inch over his starting point.

* Italics used arbitrarily to emphasize important points and render subsequent reference thereto unnecessary.

"This left the core with an endless piece of fabric covering its outer circumference and because the fabric was shorter than the outer circumference of the core, *made it conform to the cross section contour down to a point between one and one and three-quarter inches from the center line of circumference.* This amount would vary with the size of the core; on a three inch core it would contact about one inch from the center line of circumference; on a four and a half inch core it would contact around one and three quarter inches. But the point of contact on the side would always end at approximately the same percentage height above the cutting line of the core. By the cutting line I mean the point at the so-called toe of the bead where the tongue of the core attaches. It is approximately the point at which the toe of the bead is trimmed for removing excess width of fabric" (I-193).

"At the edge or end of the point of contact of fabric on the shoulder of the core, the remaining width of the ply *stood out at approximately right angles to the core,* because that was the length to which the fabric was cut before application. It was then necessary to apply these skirts of fabric as we called them to contact with the remainder of the core as far down as the cutting line. This was done with what was called a *stitching or spinning roll,* which was simply an enlarged cake or pie crust cutter with a larger wheel. The ordinary size of spinning wheel ran from one and a half to two and a half inches, and the edge went down to a sharp cutting edge just blunted over by spinning against an oil stone. This was a metal roll or wheel. The wheel was held between two supports in the shape of a yoke and a wooden handle attached.

"The ordinary method of operation for using this roll or spinning tool on the fabric and core for applying was to unclamp the set screw on the bench and turn the core and spider from a vertical to

approximately a forty-five degree position, then to clamp the supporting arm so as to hold the core and spider in that position. The pawl was then released from the hub so that the core and spider could revolve on the support, and with the handle previously mentioned as attached to one of the arms of the spider, the core was *revolved rapidly.* Because of its *weight*, approximately one hundred and fifty to two hundred and fifty pound, *it would maintain its speed of revolution for some considerable time.*

"While it was revolving the operator would take the spinning tool in his hand and apply it to the revolving core and fabric at the end of the point of contact caused by the stretching, allowing it to revolve against the fabric and core with manual *pressure applied.* He would then *gradually move it down, as the core and fabric revolved,* in a radial line, towards the cutting point of the core, until the fabric was completely applied to the entire surface of the core on one side. The operator would then shift the position of his core and spider to approximately forty-five degrees on the opposite side of the vertical position and with his spinning tool apply the opposite side or skirt of the fabric in the same manner.

"While it was ordinary practice to spin down one side at a time, I have seen workmen spin it in a vertical position using a roller in each hand to save time. But as I say, it was not ordinary because very tiring" (I-194).

"The following plies of fabric were applied in the same way until the proper thickness of tire carcass was built up."

"The method as described above of putting down one side at a time was used from 1906, by all our operators. The use of a roll in each hand was not at all ordinary. It was too hard on the men to use the two rollers throughout a day's work."

"At that time I was manager of the experimental department, which made out all construction and operating orders for mill methods."

"I not only saw it, but did it myself."

"The fabric stood out at approximately *right angles to the plane of the core.* The roller was applied to the fabric on the core at approximately an *angle of forty-five degrees* to the plane of the core" (I-195).

On cross examination, Duncan testified as follows:

"We have made tires with stretch from eight to twenty-four (per cent). *I used twelve because it is about as much as the ordinary hand worker will pull.* This might vary on an actual hand made tire as high as seventeen per cent."

"This will vary with different companies. We preferred to get seventeen."

"Because that brought what we called the neutral line of fabric to the best position on the side of the tire which could be obtained with manual stretching" (I-197).

"When the fabric is cut to a length and width for application to the core, it is cut on the bias, and the warp and filler lines are at forty-five degrees angles to the length of the strip, or a ninety degree angle to each other.

"In order to apply such a flat strip to the entire surface of the core, it is necessary to make the length of the strip at about a *medium circumference* of the core.

"As it is stretched on at the top of the core, the warp and filler yarns naturally change from a ninety degree angle to each other. *From that point to the cutting line, the angle is again changed to a greater than ninety degree difference relative to the circumferential line.* The road service shows that the nearer this neutral line, or the point at

which the warp and filler threads remain at a ninety degree angle, is to the bead seat position of the rim on the tire, the better the tire will run. A seventeen per cent stretch brought this line down *toward* the cutting line of the core about as far as could be obtained by manual stretching" (I-198).

"That (method of hand spinning) was the way we told all our operators."

"*The only time* that a saw-tooth movement of a stitcher or a spading tool need be used is when a wrinkle develops in the application by the spinning roll in the hand spinning which *necessitates lifting the fabric from the core* and straightening out the wrinkle. With a skilled operator who did not move his spinning tool too rapidly toward the cutting line in the radial line of the core, the necessity for the use of a saw-tooth movement or the spade for straightening out a wrinkle never developed. If the operator moved the tool too rapidly, he might develop one or two wrinkles which would be removed by the saw-tooth or the spade" (I-199).

"In such cases, which were very seldom, we always used the spade, in substantially a radial direction at the place where the wrinkle occurred to eradicate it" (I-200).

Upon being asked what amount of pressure was being employed to hold the stitcher against the core, Duncan replied that:

"In determining the amount necessary to apply on machine rollers, we found that tests on the hand pressure as near as we could develop amounted to about a one hundred pound spring."

"I should say it would vary from twenty-five to a hundred and fifty pounds according to how tired the man was" (I-200).

Upon being asked whether there was any tendency of the hand held roller to slip when on the side of the

core when great pressure was applied to it, Duncan answered:

> "Not when a spinning wheel of about two and a half-inches diameter was used. A small wheel would have a tendency to let the skirt of fabric catch the supporting yoke and jerk it out of position. * * * The first wheels were about an inch in diameter but were almost immediately increased from two to two and a half-inches. * * * The smaller ones were abandoned" (I-201).

Upon being asked whether in two successive operations, the first on one side of the core, and the second on the other side of the core, the amount of pressure would be uniform, he replied that—

> "I should say very unlikely, but it is immaterial, providing the fabric is applied smoothly. * * * I mean the circumferential stretch because that governs radial stretch" (I-202).

Upon being asked whether he regarded the circumferential stretch applied initially as the important thing and the side pressure subsequently applied as relatively unimportant, Duncan's testimony was that—

> "The amount of side pressure need be *only sufficient to apply the fabric smoothly. The adhesion is obtained during the molding operation*" (I-203).

And upon being asked whether there was any difference in product due to the personal equation or due to possible vagaries or lack of attention he replied that—

> "We did not notice any, we had a good inspection system" (I-203).

Tod J. Mell of Akron, Ohio, technical adviser to the superintendent of The Firestone Tire & Rubber Company, was connected with The Republic Rubber Com-

pany of Youngstown, Ohio, from 1905 for eleven years, first as manager of the tire department for five years, and then as experimental engineer (I-152, 3). Mell said that they made tires by hand at the Republic company in the fall of 1905, and got the department well under way in 1906, and described how the fabric was put on the core, as follows:

> "The fabric was cut the proper width on the bias, a strip made the proper length to reach round the core of the tire, *after being stretched.* I should have said at first that the core was cemented, in order that the fabric would stick to the iron. After the ply had been stretched on the core and spliced, it was rolled down, starting at the tread and working down well over the sides. As the fabric was stretched, it tended to lay down to some extent over the sides of the core. The operator, after he had rolled the tread, *rotated the core until a sufficient speed was obtained,* and then, at first by means of his roller, *and later with his stitcher,* rolled the fabric on to the core" (I-153).
>
> "The motion was then stopped and the tire turned in a horizontal position; and in this position the operator finished working the fabric on to the core. The plies were put on in this manner until sufficient plies under the bead had been placed; then the bead was placed and additional plies of fabric stretched, and rolled on to the tire; after which the tire was trimmed at the bead and the rubber side wall and tread applied. The tire was then *cured* in the usual manner that all full-molded tires are cured in" (I-154).

Mell said that *"Owing to the centrifugal force, the edges of the fabric stood away from the core to some extent"*; and that the method described by him was *the regular practice at the Republic Company in 1906* (I-154).

Upon cross examination, Mell said that the method described by him "*Was the accepted method up until the time a machine was used,*" and that *no other method was employed in the Republic plant,* "Except possibly experimental method or methods." Also that the same method was used on all sizes of tires by the Republic company "*Up to and including 5-inch*" (I-155).

Upon having his attention called to the "reciprocating stitching method," Mell testified that:—

> "After the fabric was applied to the core and the tire spun and the operator had worked down with his stitcher, while the tire was spinning, all the fabric that he could, he stopped the core and used the paddle, and sometimes a stitcher, to stretch the fabric and make it lay smoothly the balance of the space to the inside diameter of the tire. I wouldn't say that he worked it down that way. The path shown in the sketch is at an angle with the radial line of the tire. The method used in stretching the fabric on with a paddle was to stretch very *near to the radial line;* In other words, we worked towards the axis of the tire, instead of at an angle" (I-155, 6).

Upon being asked whether the Republic company ever employed the reciprocating stitching action all the way down to the bead line, Mell said that—

> "*I do not believe that we ever did.* All of the tires were rolled down to some extent, varying with the experience of the operator, before the paddle was used" (I-156).

When asked whether on a small core having a cross section of say three inches, with a fabric stretch of 18 or 20 per cent elongation, there was very little additional forming action necessary to apply the fabric to the side of the core, Mell replied that—

"Yes, not a great deal of the additional forming need be done. However, the fabric had to be applied without wrinkles; and even on a small tire this took considerable care, the fabric *never coming down* where it lay on the core in its correct position.

"Certain companies, in order to make the operation of applying the fabric easy, stretch their plies to a considerable extent; but even when this is done I would not say that they relied principally upon the stretch, as it was *always necessary to place the fabric in its proper position by other means*" (I-157).

Walter S. Koplin, an employee and sometime inspector of The Firestone Tire & Rubber Company, was engaged with The Diamond Rubber Company in the work of making hand built tires some four years from 1903, and served as an inspector for seven years thereafter (I-92, 3); described how they put the fabric on the core when he built tires there by hand, as follows:

> "We stretched fabric on by hand, and we made our splice; then we rolled it on top—Oh, about three inches, I should judge; and we were *supposed* to stitch it down, but when a man got used to it they would start the core to *spinning as fast as it could* and the *fabric stuck out*—why, we let it run that way until we got clear down to the bead. Then, of course, it would bring it down into the groove of the bead and then right over the edge" (I-93).

On cross examination, Koplin testified that in breaking in new men the rule was to "*To stitch the plies down by hand,*" but that "*After we would break them in, they would naturally break away from the hand building, and as I told you before, spin the tire*" (I-96).

On being asked how much weight he estimated is used in Firestone machines for holding the stitcher or

forming-roll on the tire against the core Koplin answered—

> "I should say *there isn't any more than a man can use.* * * * Just what a person could bear his weight against there, and his strength too—bears right up against the tire. * * * I should judge it would be about 30 or 40 lbs" (I-98, 9).

Charles H. Drach of Akron, Ohio, an employee of The Firestone Tire & Rubber Company, worked for The Diamond Rubber Company for three months in 1905, and went back in 1906 and worked there about four years and eight months (I-99). When he went to the Diamond in 1906 he built tires by hand, and described how he put the fabric on the core, as follows:

> "Well, we first cemented the core, and started the ply on top of the iron core, and pulled it around; then we took and *spun the core real fast*, and *held stitcher against it, right down to the bead line*" (I-100).

Drach says that when he spun the core real fast the edges of the fabric were "*Right out, right out straight*"; that when he went to the Diamond company in 1906 he did this spinning down of the fabric—

> "Right away, when the rest of them was doing it I started, right away. * * * They all done it, the gang I was in, twelve men" (I-100).

On cross examination, Drach referred to the so-called "stitching method" and said that "*It drawed the stock to the core more by spinning it than it did by stitching it*" (I-103); and upon redirect examination, he said that in his own experience he got "*More stretch with spinning*" (I-105).

Cary D. Derry of Kent, Ohio, an employee of The Firestone Tire & Rubber Company worked for The Diamond Rubber Company in the forepart of 1904 in making hand built tires (I-107); and described how they put the fabric on the core in building those tires by hand, as follows:

> "Well, we pull the fabric on by hand. The core is cemented all over. We pulled it around by hand. And to stitch the fabric down you were supposed to stitch it by stroke. Practically all of them did" (I-107).

Derry further testified that they "*Spun the core and used the stitcher*"; also that when they spun the core the fabric took "*Kind of an upward course, flared out*"; that they spun the core "*Fast as we could*" (I-107); and described the use of the stitcher when they spun the core, as follows:

> "Well, spin the core, get it going *as fast as you could;* take your stitcher and hold it just about that angle, as near as I can tell you; be *about forty-five degrees,* wouldn't it" (I-108).

On cross examination, Derry explained that they spun the core to give it a high velocity—

> "To make your number good deal easier, to *get the speed to pull the fabric down.* Run it on low speed, wouldn't flare out; *on high speed, it would flare out.* * * * So that the fabric wouldn't wrinkle" (I-111).

Derry said further that if you rotated the core at a less velocity:

> "The stitcher *wouldn't take a hold.* If the fabric *wouldn't flare out,* the stitcher wouldn't take hold. As fast as the core would go the fabric would flare out and *give the stitcher a chance to take hold*" (I-112).

As to the amount of pressure exerted in holding the stitcher or forming roll against the side of the tire, Derry said that *"I should judge in the neighborhood of 25 or 30 lbs., along there, as near as I can tell you"* (I-112); and also that *I don't think there would be very much of a variation"* of pressure on the two sides of the tire (I-113).

William Heller of Akron, Ohio, an inspector of tire carcasses at the factory of The Firestone Tire & Rubber Company, started work with The Diamond Rubber Company in 1901 and stayed there for about four years, and started building tires in 1902 (I-115), as follows:

> "At the time, why, we pulled it on in first place on wooden core, and then we experimented getting it down most any ways; used to pull it down with pliers, wire pliers, nail it fast with tacks, tacked it down; worked it down, stitched it down, worked the core; then we used to have a paddle there; we used to chop it down; that's what the boys used to call it them days—chop it down" (I-116).

About two years later, in 1904, they began making tires on iron cores, as follows:

> "I pulled the fabric on in the ply. Always cut in plies. And then, after the plies were on the tire, splices made, either stitch it down by hand *or whirl the core, hold the stitcher against the core and spin it right down"* (I-116).

Heller said further that they whirled the core *"Just as fast as we could. That depends on the size of the core. Heavier the core the faster it spun"*; and that when the core was spinning fast, the edges of the fabric took a position *"straight out"* (I-117).

Louis Stark of Akron, Ohio, General Tire Department foreman of The Miller Rubber Company, began making tires by hand at The Diamond Rubber Company

on wooden cores in 1901 and 1902, and on iron cores about 1903 (I-125, 6). Stark said that the fabric was put on the iron cores, as follows:

> "We pulled the fabric on by hand. The first ply was made up in an endless band. * * * Pulled them on by hand. * * * Well, there is a number of ways you could do that. I used to do it the quickest way—*spinning the core,* holding your stitcher on the side of the fabric and *running the ply down.* * * * Well, I started it right after I started to build tires there on iron cores. * * * Well, now, I don't know as I can say just how fast the core was going; but you had to spin it *just as fast as you could possibly get it to spin.* * * * Well, the faster you would spin the core, the *fabric would stand out* like this,—*right out straight from the core*" (I-126, 7).

On cross examination, Stark thought he was able to press the stitcher against the core *with the same amount of pressure as that now ordinarily imparted to a spinning or forming roll in the present well-known form of carcass making machine,* and testified as follows:

> "I couldn't say how much pressure I did put on. I never had any idea at all. I *always got enough on there to get them down where they should be*" (I-128).

In further cross examination, Stark said that he did not think the pressure was great enough to retard the rotation of the core "*because it kept on spinning all the time*" (I- 129).

William G. Green of Akron, Ohio, an employee of The Firestone Tire & Rubber Company ever since 1906, was previously employed by The B. F. Goodrich Company, and while there made automobile tires on iron cores (I-136). Green described how they put the fabric on the cores when he made tires at the Goodrich plant, as follows:

"We hung a core up on posts. We had posts with pins sticking out, and we hung it up by hand and pulled the fabric on.

"We had to *spin the table* around and *stitch it down by hand.*

"Why, we had a revolving table, and use a paddle sometimes, and *lots of times we used the stitcher most of the time*, well, *biggest part of the time.*"

"(It) was a ball-bearing table, and they whirled it, see? get it going *fast*, and they held the stitcher there." (I-136, 7).

Green testified further, that he did that himself and that he had seen other men at the **Goodrich plant** stitch down the fabric by whirling the core as described; and upon being asked what position did the edges of the fabric take, replied:

"Well, the upper edge of the fabric on top *would flare up, naturally*" (I-137).

Green also said that the core was whirled "*as fast as we could whirl it. The faster the better.*"

Warren C. Gregg of Akron, Ohio, an inspector of tires at The Firestone Tire & Rubber Company for some eight years, worked for The Diamond Rubber Company twice before that time, leaving the first time in 1907 (I-146, 7): and when he was there the first time, made tires by hand, as follows:

"We had, to start with, a band; it was an endless band; that two of us stretched over a core. Then we worked it down with a stitcher.

"Well, if we worked it down according to our instructions, it was done with stroke. Often they would spin the core, and then would *hold the stitcher against the sides* of the core; hold the stitcher

there—of course, if we had speed enough to start with, we would run it clear down.

"Well, we figured on spinning it fast enough to make it run until we got this fabric run down to the bead line" (I-147).

When asked what position did the edge of the fabric take, Gregg answered—*"Why, ordinary stand straight out, flare out"*; and said further that he saw other men spin down the fabric in this way at that time (I-147).

Mark W. Roe of Akron, Ohio, a Mechanical Engineer engaged as Consulting Engineer with The Republic Rubber Company since 1917, was Assistant Engineer with The Diamond Rubber Company, and its successor The B. F. Goodrich Company, from April 1907 until August 1915 (I-167). Roe testified that tires were made by hand at the Diamond Company in 1907 and described how the fabric was formed on the core at that time, as follows:

"The fabric was received by the men cut in bias strips. The ends of these strips were placed upon the core and stretched around the core by the manual power of the operator, after which the core, with the ply of fabric, was revolved by hand, and *spinning wheel or stitcher*, hand-operated, was used for stitching down the fabric around what would form the bead."

"The core was caused to rotate by the left hand of the operator, spinning tool being held in the right hand, the spinning end of the tool downward, and forced against the tire, usually starting from the center or outside periphery and *worked in a spiral line*, forcing the fabric to the core, as the spinning tool was advanced, *radially* toward the center of the core.

"It would be hard to say, but I should judge (the core is rotated) from 50 to 60 revolutions per minute. It would average about that" (I-167-8).

On cross examination, Roe testified that—

> "So far as I remember, wrinkles or uneven places obtained in stitching a tire were smoothed out by paddle or stitcher along the principle as shown in the 'Sawtooth Path Sketch' " (I-170).
>
> "To the best of my knowledge, it was in common use at the Diamond plant,—to stitch them down that way. I mean in common use to stitch them down by the stitcher, *by rotating the core*" (I-171).

Upon being asked whether the *amount of pressure* exerted on the stitcher in following the spiral path is more or less immaterial, Roe said that—

> "No, it should not be less than a certain amount, nor greater than a certain other amount, the definite limits of which I have not fixed."

Harvey J. Bittaker of Akron, Ohio, Assistant Manager of the Cord Tire Department of The Firestone Tire & Rubber Company since 1913, was employed from 1896 to 1913 as inspector and foreman in the Bicycle Department and as inspector and foreman in the construction of automobile tires with The Diamond Rubber Company (I-173, 4). Bittaker said that The Diamond Company began making automobile tires on iron cores about the year 1900, and continued that practice until sometime thereafter, and described how they put the fabric on the iron core, as follows:

> "The construction of the tire began by the application of a first ply, which was put on in a band form. The core was then *revolved*, and the plies were stitched down on the side of the core, additional plies being added that were not put on in the band form were rolled and stitched down in a similar manner" (I-174).
>
> "There was no roller used on the band ply; but the several additional plies were rolled down,

that is, on top of the core, with a flat roller, and some with a curvature roller. They were rolled down to a point on the core about half way between the top and the bead line. *Then the stitcher was applied,* and the balance of the fabric was stitched down with a stitcher about three and a half inches in diameter, and about a one-sixteenth inch face'' (I-174, 5).

''In the early stages of the tire construction, *rotating of the core while stitching down the plies* was sort of termed as a criminal offense among the employees. Shortly after the tire construction had advanced, *it was more common to see the workmen rotate the core at a very high speed* while applying the fabric with the stitcher'' (I-175).

''About the year 1902 or 1903'' (I-175).

''The edges of the fabric were sort of *flared out or spread out* on the sides while the core was being rotated'' (I-175, 6).

On cross examination, Bittaker explained why the hand-spinning operation at the Diamond plant was regarded as a species of criminal offense, as follows:

''In the beginning of tire construction, it was more *theoretical* than anything else that the threads of which the fabric was composed could not be kept at a 45-degree angle while being applied to the tire, if stitched down *while the core was rotating;* but, after the mechanics who were studying the proposition got into it more thoroughly, they found out that applying the fabric while the *core was spinning* was not detrimental to the tire, as they had previously thought'' (I-180).

In explaining why the workmen preferred to use the hand spinning method, rather than this saw tooth method, Bittaker said that—

''The fabric could be applied more easily and in less time, naturally.''

"They considered that the hand spinning was not so laborious. It was easier, but wasn't quicker. Easier on their arm. That was the point."

"Yes, it was quicker as well as easier" (I-182).

Talcut I. Curtis of Trenton, N. J., was demonstrator for the DeLaski & Thropp Circular Woven Tire Company, and made tires for them by hand in 1905 (I-293). He described how he put the fabric on the core in making tires in 1905, as follows:

"We mounted the core on a three pronged spider stand, cemented the core, stretched the fabric on, spliced it, and then rolled it down with a three-inch stitcher, *rolling* stitcher.

"The rolling down I did in two ways: First, holding the stitcher with both hands, *by rotating the core first*, holding the stitcher with both hands, going down one side and then down the other side."

"The other method was in *revolving the core* with the left hand and stitching down with the right, turning the core from the other side—spinning it down" (I-294).

Curtis said further that when the core was rotating in the first method—"The *edges flared out* to a certain extent according to the swiftness of the core" (I-294); and also that he followed the same method at the Empire plant in 1906.

Concerning the use of wooden spades Curtis testified that—

"Well, I used, sometimes the spade at that time. We used them both possibly at that time, some. Some fabric is stiffer than others and so on, and they changed over to the other methods possibly a little" (I-296).

Thomas A. Walch of Trenton, N. J., foreman of the Tire Manufacturing Department of Ajax Rubber Com-

pany, was employed by the Ajax company for thirteen years from 1906 and in that year made tires by hand (I-285, 6). Walch described how they applied the fabric to the core, as follows:

> "Well, we had three and four prong spiders; we would have a slot in the core and we would put it on this spider; then we had a wrench to tighten it up with screws on the top—adjustable screws; you could turn it until you got it tight enough; then we mounted the core and put a little cement across the top and all around the side, about half way of the core; then we started our fabric and started to pull it on just as hard as we could, cut it off and spliced it; and then we would start and turn our core around *just as fast as we could*, and then we would take this *stitcher*, three inch stitcher they called it, a steel stitcher, about a sixteenth of an inch on the point, and we would go right in like that (indicating) toward the bead and the same on the other side" (I-286).

When asked what position did the edges of the fabric take when you turned the core as fast as you could, Walch said—

> "Well *it stuck out*, just like that (indicating) *laid out*" (I-286).

On being asked in cross examination, whether men when they first started would use a wooden spade to spin the fabric down on the core in the way that Walch did it, he answered—

> "No, not with the wooden spade; you had to have it *stationary;* went all around it and took much longer to do it."

> "Well, the new fellows that would start in, they would always do it with the spade starting in, be cause it was quite a knack to do it with the stitcher.

We learned a lot of new men there and they did not quite get the knack of doing it right away" (I-288).

As to whether the quality of fabric tires and their durability has materially improved in the last thirteen years (previous to 1919), Walch testified that—

> "Well, we use the same kind of fabric, very near the same kind of compound. I don't know as they have durability any better. I *believe the hand made tire was considered just as good as far as durability goes as a machine made tire*" (I-288).

On this subject Walch said further that they got as good mileage out of hand made tires in 1906 as they do out of machine made tires today, and that "*They were guaranteed five thousand miles*" in 1906, "*the same as they are today*" (I-289).

As to the amount of pressure to which he applied the stitcher to the side of the core, Walch said that—

> "Well, it was *not a great pressure*—just enough to stick the fabric to the cement; there was some on the inside, just to touch the fabric; very little pressure * * * not to amount to anything; *you had to hold the stitcher steady;* that is the way you held it, the pressure, you didn't have to put on much pressure at all" (I-290).

Walch said that the Ajax company used a stretch of "*six per cent*" in applying the layer originally to the core by the hand spinning method, his experience being confined entirely to the Ajax practice.

In summarizing the testimony of the foregoing witnesses, an effort has been made to include only those statements which are not affected or modified in any manner by the rigid cross examination to which they were subjected; and it is believed that the testimony which has been quoted stands undisputed in the record

and may be accepted as conclusive of the facts set forth therein, without the need of any argument to establish the same.

It is only necessary to note that some confusion occasionally arises from the frequent use of the words *"stitching roll"* or *"stitching wheel,"* to designate the *spinning roll* or *spinning wheel;* and this fact sometimes makes it difficult to understand whether a witness was referring to the "reciprocating" or "saw-tooth" method which may be practiced, either by a "spade" or "paddle" or by a "stitching" roll, or to the "spinning" method which is also practiced by the use of a "stitching" roll.

The testimony of the witnesses will be more readily understood if it is remembered that the *"stitching"* method can only be practiced by hand when the core is stationary or rotating very slowly; while the *"spinning"* method can only be practiced by *rotating or spinning the core very rapidly.*

Hand Spinning Admitted by State.

In view of the common practice of hand spinning tires in many factories prior to the development of the State machine, it is not surprising that the previous use of this method was recognized in the specification of the State patent, as follows:

> "The spinning-rolls 147 are preferably mounted on ball-bearings or similar anti-friction mechanism for they revolve at high speed and exert considerable pressure on the fabric. * * * The spinning-rolls are also shown as spring-pressed toward the plane of the ring-core by springs 145. * * *These springs exert the pressure against the fabric for forming it against the sides of the core which would be exerted by the arm of the workman in case of a*

hand-tool or a hand-pressed roll" (Lines 93 to 117, page 5 of the State patent. II-19).

Nor is it surprising that the patentee testified to the knowledge of the hand spinning method, prior to the time he began his experiments, as follows:

"Q. 48. Now, I want to call your attention to another alleged system of making tires by hand, which we will call the 'hand-spinning' method, which is distinguished from the sawtooth method you have already described by the fact that a wheel-stitcher was employed to roll down the unattached skirts, the core being rotated with some alleged degree of rapidity, and the stitcher being held in the hand and gradually advanced by the operator over the side of the rotating core. Do you know what I mean by this description?

"A. Yes, I do.

"Q. 49. Was that method ever used in the Goodyear plant prior to the time that you began your experiments you have already referred to?

"A. I never knew it to.

"Q. 50. Had you ever seen that method employed prior to the time you began your experiments?

"A. No, I had not.

"Q. 51. Had you ever heard of it?

"A. Yes, *I had heard of it* (I-308).

"Q. 52. Do you remember how you heard of it?

"A. *I had heard of that through McDonald.*

"Q. 53. But you had never seen it actually—

"A. Had never seen it operated.

"Q. 54. Did McDonald ever demonstrate it, or illustrate it, to you in actual practice?

"A. Yes.

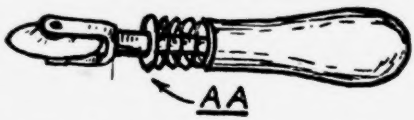
"Q. 55. What was your purpose in having this illustration and demonstration of the handspinning method made to you by McDonald?

"A. I had started an experiment, *and asked him to roll it down for me with the spinning roller.*

"Q. 56. You say that you started a series of experiments some time in the year 1907, with the idea of obtaining a commercial machine. Did McDonald's demonstration and illustration of this handspinning method form any part of these experiments?

"A. It did" (I-309).

The patentee also recognized the prior existence and use of hand stitching rolls, by including an illustration of the same in "Plaintiff's Exhibit No. 8—Sketches of Experimental Work, (3rd Device)"; the same being designated "*A A*" in the sketch, and being described in his testimony as a "Standard Stitcher-Roller" (I-343).



Furthermore, State says that in his "Sketch 15" (II-97), the figure at the top, to the left, entitled "Hand stitcher-wheel," is intended to represent the ordinary hand stitcher-wheel in use prior to the beginning of his experiments (I-368).

And finally, **Arthur R. Mackey,** plaintiff's own witness, who worked for the Diamond company in 1908 or 1909—between 1907 and 1909, first as a tire builder and afterwards as an inspector of tire construction, described an unofficial method employed there for forming the sides of the ply to the core, as follows:

"We first stretched the ply of fabric on the core, and then *spun the core* as rapidly as we could by hand, and then *rolled the fabric down* on the side of the core by a stitcher held in the hand by the operator, *moving the hand inwardly down toward the*

bead. When the plies were stretched on tight and even, we could spin down to the bead, and sometimes out to the heel of the bead" (I-416).

"The stitcher of smaller diameter was the first small stitcher used in tire construction; and afterwards found that the hub of the stitcher would buckle into the plies too often, and larger stitcher was made. These larger stitchers *we got at the hardware store*, our own buy; we bought them ourselves.

"The factories did furnish some, but that was in the first initiating of those first stitchers; and the workmen bought a good many of them themselves" (I-427).

This testimony, produced by the plaintiff, shows that the larger sized stitchers, which were particularly used in the hand spinning operation, were in such common use in 1907 or 1908 that they were obtainable as an article of merchandise in a hardware store.

Hand Spinning Not Entirely Manual.

It is interesting, if not important, to note that the so called "hand spinning" method of building tires is not entirely a manual operation, but involves the use of a circular core mounted on a spindle for rapid rotation, and also the use of a disk-like spinning roll, also mounted on a spindle for rapid rotation; and as each one is a *wheel*, axially journaled for turning when power is applied, to that extent each one is a *machine*, and both were used in carrying out the hand spinning method.

This fact seems to be important because, whether or not "*There is no true combination between State's revolving core and his independent spinning tool,*" as was said by Circuit Judge *Denison* in deciding the *Firestone* case (Pet. for Cert. p. 34); it does not seem

necessary to determine that question in the present case, for the reason that the exact association of mechanical elements, whether it be aggregation or combination, was present in the prior practice of hand spinning tires.

At any event, the prior practice shown by all the witnesses who have testified on this point, and admitted by State the patentee, completely anticipates the *method*, and the *mode of operation* of the machine of the State patent; including the initial *longitudinal stretching* of the fabric, the *application* of the same *around the tread portion* of a core, the *rapid rotation* of the core, the *spinning down* of the fabric on the sides of the core *gradually* by radially moving spinning rolls *pressed against* the sides of the core, and the *action of centrifugal force* to throw out the unattached skirts of the fabric from the sides of the core to *frictionally engage* around the edges of the spinning rolls and be *radially stretched* thereby.

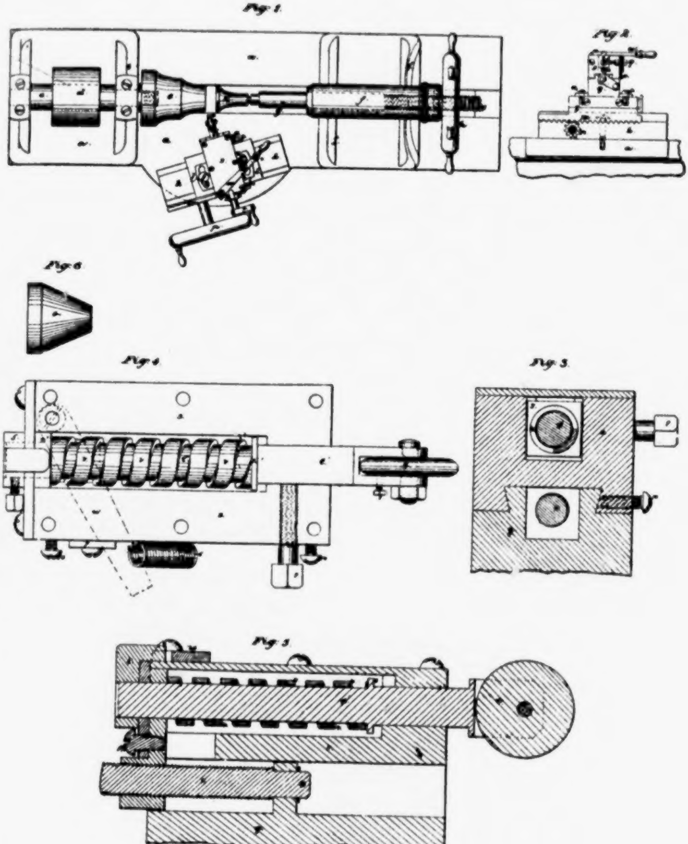
PRIOR PATENTS.

Although the quasi manual method of building automobile tires was well known and in common practice before a more mechanical apparatus was developed for performing the same process; the same methods, in all substantial respects, had long been used in the work of spinning metal sheets and bicycle tires, by apparatus having the same association of mechanical parts and the same modes of operation, in every substantial respect.

Among the representative prior patents appearing in the record, are three machine or apparatus patents for spinning metal sheets; and a reading of these patents shows that they disclose associated devices for performing the same functions by the same means and by the same methods, which were subsequently employed for building automobile tires.

The early Seymour patent, No. 80,836 of August 11, 1868, for an Improvement in Machinery for Spinning or Burnishing Articles of Sheet Metal, explains the objects and purposes of the patented invention, as follows:

> "Machines have heretofore been made for operating upon disks of sheet metal, to spin them up to the shape of a chuck or former, the said chuck or former and the sheet metal *revolving against a roller* that is held to said sheet metal by a *slide-rest,* to which motion is given to cause the roller to *move along* the surface of the chuck or former, as may be seen in the French patent of Japy Brothers, dated March 1, 1836.
>
> "The nature of my said invention consists in mechanism for holding a roll or burnisher with a *yielding* or *elastic* power against the *revolving sheet metal and former,* so that the spinning up of articles of sheet metal can be done with a tool that is held by mechanism that will *yield to the curvatures* of the former or chuck, and operate *similarly to the spinning of sheet-metal articles by hand.*
>
> "By my mechanism, irregular shapes, such as used for lamps, oil-cans, etc., can be spun up with great speed and precision by a workman with but little experience or bodily strength, while the spinning of large articles of sheet metal has heretofore required a workman with considerable experience and bodily strength to hold the tool.



Early Seymour Patent No. 80,836 (II-324).

"My improvements are adapted to spinning up of regular conical articles in sheet metal, but are more particularly available in spinning up ornamental articles formed with curved sides or angular bends, forming bands or varying shaped circular articles, *now spun up by hand* or pressed up in dies."

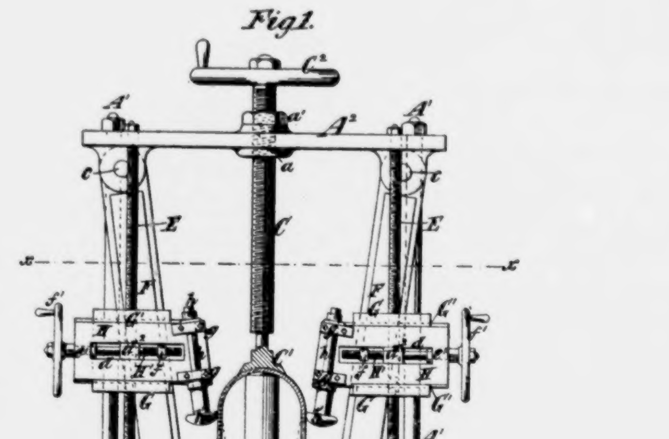
"By the apparatus constructed as aforesaid, the *workman is relieved from the labor of holding the tool while the spinning operation is performed,* and he is able to guide and direct his tool with precision, in a manner corresponding generally to that employed in turning metals with a slide-rest; and, in addition to the *yielding* force applied to the tool, to cause it to conform to the shape of the chuck or former, the screw *r* and hand-wheel *p* place the tool under the direction of the attendant, and if the spring *v* is too powerful for any particular character of work, its force may be lessened by the hand acting to draw back the lever *w*" (II-325, 6).

This first Seymour patent recognizes an earlier practice of spinning sheet metal articles by hand, and as clearly shown in the drawings and described in the specification, the quasi mechanical apparatus set forth in the patent embodies a *power driven, revolving mandrel,* and a *cooperating spinning roller mechanically mounted for moving along the mandrel at a retreating angle from the direction of its movement, and with a yielding pressure against the surface thereof;* and it may be asked at this point—What more does the State patent set forth, with respect to the association and mode of operation of the spinning roll and revolving core?

As the machine or apparatus of this patent operates upon disks of sheet metal, forming regular conical articles or ornamental articles with curved sides, it is evident that there must be a *radial elongation or displacement* of the metal in the disk corresponding to the

circumferential contraction of the same necessary to form the reduced diameter of the sides of the article; just as there is said to be a *radial stretch* and *longitudinal constriction of the edge of the fabric in an automobile tire.*

The later Seymour patent, No. 376,167 of January 10, 1888, for Improvement in Machines for Shaping Wrought-Metal Cylinders or Shells, describes the machine, which is well illustrated in the drawing, as follows:



Later Seymour Patent No. 376,167 (II-328).

"This machine comprises a base portion or bed-plate, upon which are erected columns or posts, and a head or top plate surmounting such columns or posts. It also has a central *rotary mandrel* or spindle, upon which the cylinder to be operated upon is placed, and a rotary and screw-actuated steadiment, which may be brought down upon the closed end of the cylinder to hold it upon the mandrel or spindle. By the rotation of the mandrel or spindle the cylindric shell to be operated upon, whether in a *heated* or cold state, is turned or rotated. At opposite sides of the central mandrel or spindle are two carriages, each containing a *slide having mounted upon it a rotary spinning wheel* or tool, and by means of vertical *feed-screws* these carriages and their slides and tools are moved upward and downward or traversed along the cylinder.

"The two carriages are mounted upon slideways or guides, which may be pivoted at one end, as at the top, and adjustable by means of adjusting-screws toward and from the central mandrel or spindle at their lower ends. As the carriages and their slides and tools are traversed up or down by the feed-screws, they will follow the direction of these slideways or guide-bars, and if the slideways or guide-bars are set with an inward inclination toward the central mandrel or spindle the carriages and their slides and tools as they traverse downward will be gradually moved inward toward the mandrel or spindle, and will thereby impart to the cylindric shell operated upon a *downward-tapering form*, such as would be required for the air-chamber of a pump.

"By means of the adjusting screws, which are at the lower end of the guide-bars, they may be set inward or outward relatively to the central mandrel or spindle, so that the *spinning tools* or wheels will be moved downward in lines parallel with the mandrel or spindle for producing straight work, or in lines more or less inclined relatively to the central

axis for producing a downward taper or downwardly-flaring work" (II-331).

This second Seymour patent shows quasi mechanical apparatus including the same associated mechanical elements as the early Seymour patent, in which all the movements of the spinning roll with reference to the work, are *mechanically controlled,* with means for *manually adjusting* the pressure and movement of the spinning rolls to and from the work.

The patentee also states that "*The cylindric shell D may be operated upon by my improved machine either in a hot or cold state*" (II-333); and this statement seems to imply a *displacement* of the metal by the action of the spinning rolls, to produce a *stretching or elongation* of the sheet in a direction normal to that in which it is *circumferentially contracted* by the advancing operation of the spinning rolls.

The Dewey patent, No. 438,407 of October 14, 1890, for Improvements in Apparatus for Forming or Shaping Sheet Metal Electrically, illustrates and describes a similar association of the same mechanical elements for operating upon a sheet metal disk by passing a heating current of electricity through it, while a spinning roll co-operates with a revolving mold to form the disk into a cup shaped ring. The patentee describes the method employed and the mode of operation of his apparatus, as follows:

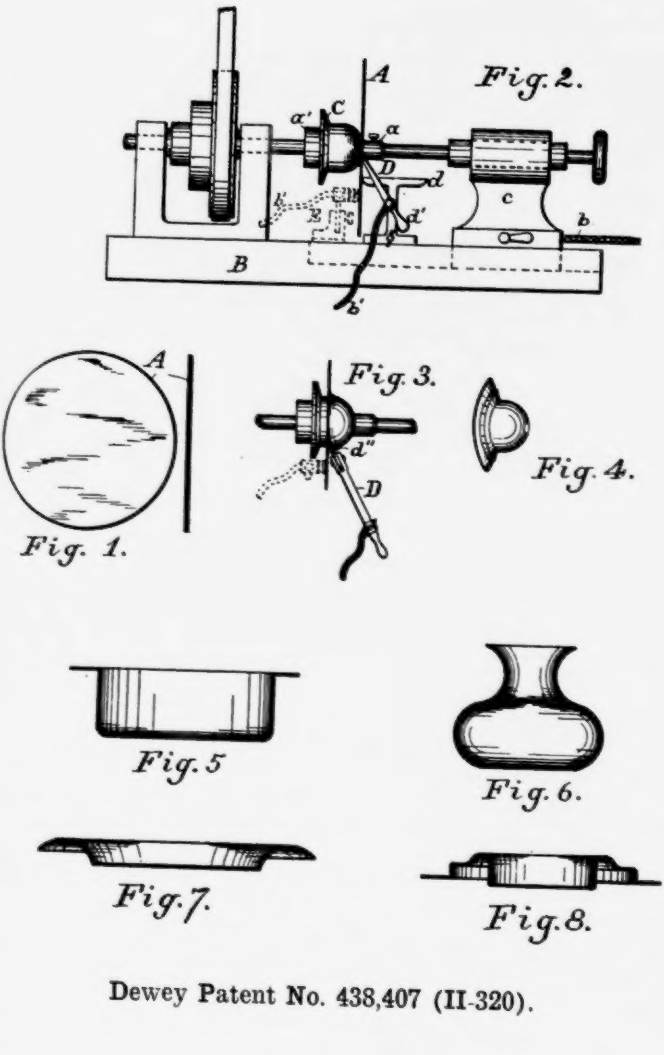
> "My invention relates to certain apparatus for use in my process or method of forming sheet-metal articles which requires the employment of heat to soften or anneal the metal, and the application of pressure to gradually conform the sheet to the surface of a suitable die or mold.

"The process depends for its success upon the *malleability* of the metal; and it is the purpose of my invention to keep the metal annealed or in a softened condition during a greater part of if not the entire or complete formation of the article and to decrease the number of molds as well as the number of pressings usually required in forming or shaping the article, and also to save time and handling.

"The *pressure-instrument* D is held upon the lathe-rest *d* as a fulcrum, and while the disk A and mold C are *revolved* said instrument is applied to the disk near the center, which is rapidly bent or swaged, so as to fit close against the curved face of the mold. The instrument D may be held and moved by any suitable means, but preferably in the hand and by the handle *d'*. A gentle pressure is caused to bear on one point, thus producing a slight depression; but as the sheet is spinning at high velocity the depression at once forms a circle, and so by continuing the pressure of the instrument and gradually moving the same the sheet is molded into any form accordingly.

"Various forms of pressure instruments or burnishers may be used, the one shown in Fig. 3 being *provided with a roll d''* to decrease the friction between the bearing points."

"It will be also apparent that the sheet of metal may be by this method maintained in a heated, softened, or annealed condition during the entire formation of the article, if desired, and that with suitable current-regulating devices in circuit the sheet may be kept at any temperature desired without danger of burning or heating the sheet metal too much" (II-321,2).



Dewey Patent No. 438,407 (II-320).

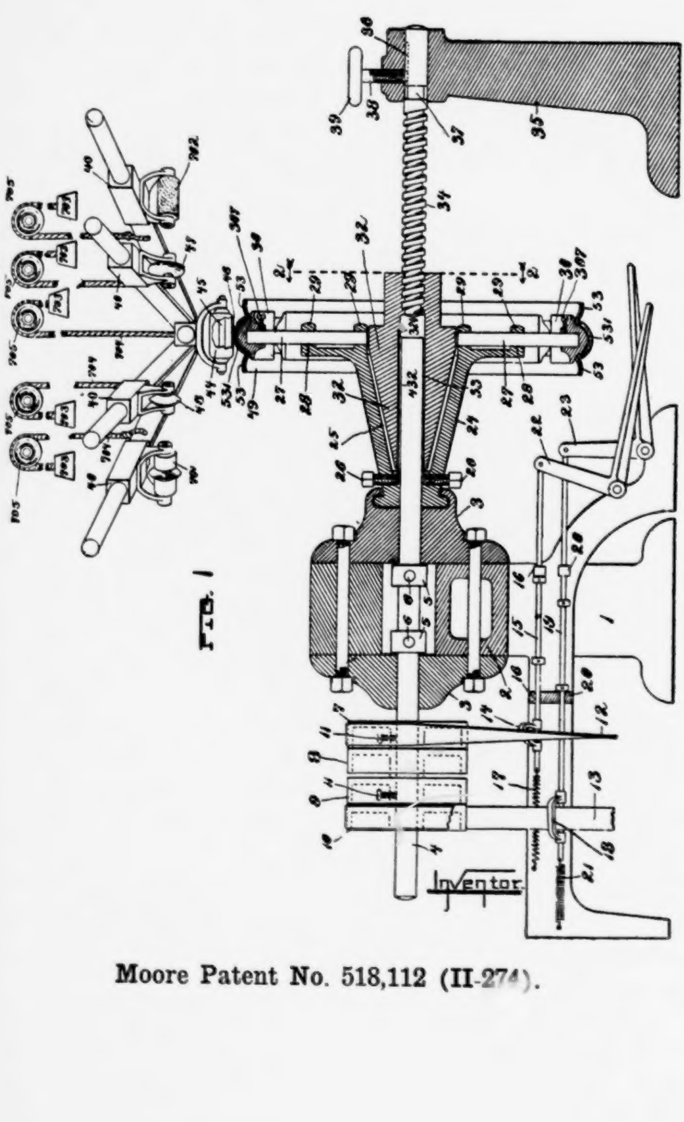
No functional difference is seen between the *radial displacement, stretching* or *elongation* of the malleable metal, which is necessarily required to cause the *circumferential contraction* thereof in the formation of a cup shaped article from a flat disk; as compared with the like *radial displacement, stretching* or *elongation* of the rubber saturated fabric which may be required to cause a *circumferential contraction* thereof in the formation of a tubular tire from a cylindric strip of fabric.

This conclusion is supported by the testimony of plaintiff's expert, Arthur S. Brown, as follows:

> "In metal spinning, the metal is made to *flow*. That is to say, the metal is *displaced* from one position to another. The metal cannot be changed greatly in shape except at several stages between which the metal has to be heated, or else the metal has to be maintained hot" (I-494).

In the same sense, it is believed that as far as the function of a method or a machine is concerned, the rubberized fabric is made to *flow*, and is *displaced* from one position to another; not by a heating thereof as may be required for a metal, but by the inherent *elastic* or *ductile* character of the material.

The Moore patent, No. 518,112 of April 10, 1894, for Improvements in Machines for Making Shoes or Covers for Pneumatic Tires, illustrates and describes an application or adaptation of substantially the same method and



Moore Patent No. 518,112 (II-274).

mode of mechanical operations in the manufacture of bicycle tires; in which a ring shell is employed as a form for the fabric, the same being mounted upon an expanding spider for *stretching* the fabric, and is provided with power driven mechanism for rotating the core-shell at a *high rate of speed*, while disk-like rollers mounted on levers are manually applied to the fabric for the purpose of smoothing and stretching the same into proper position and condition.

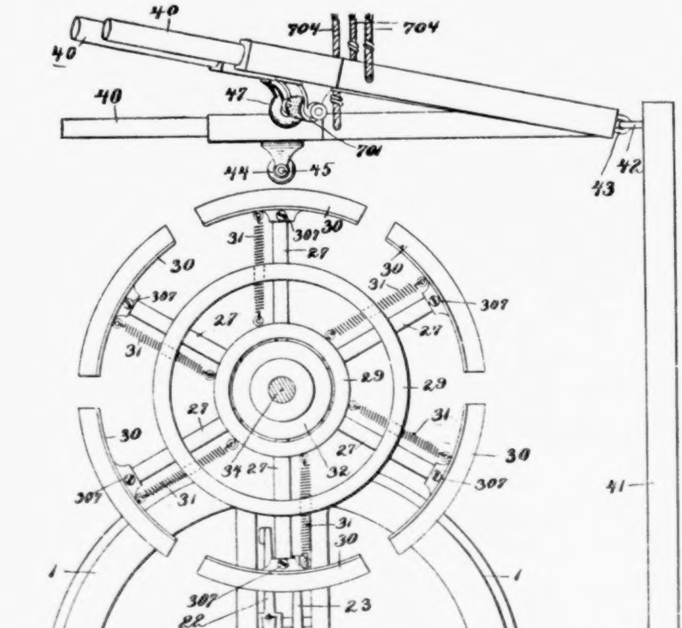
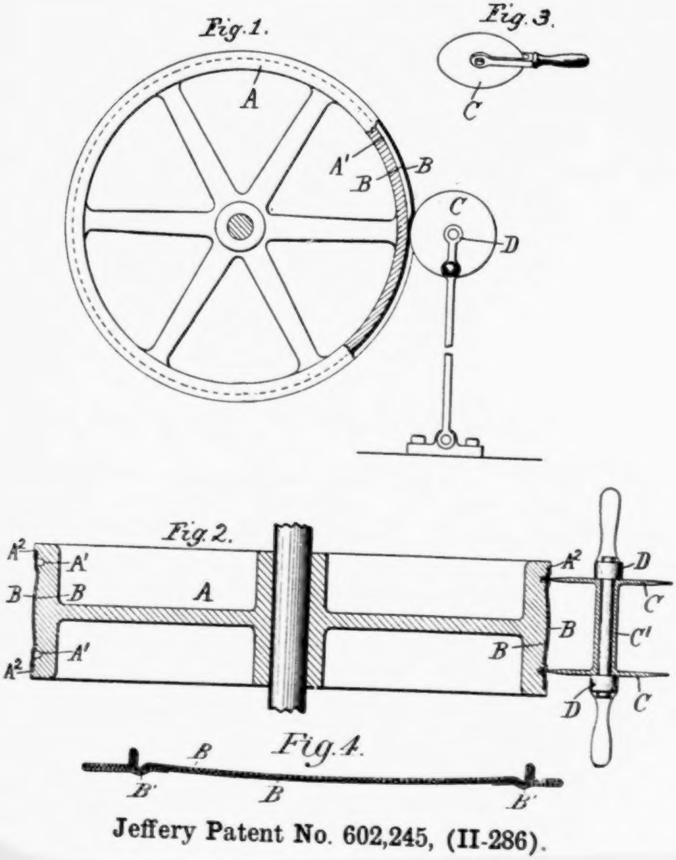


FIG. 2.

Moore Patent No. 518,112 (II-276).

A mere inspection of the drawings of this patent is sufficient to show that as far as function or mode of operation is concerned, the machine or apparatus is a mere adaptation of the method and mode of operation disclosed in the prior metal-spinning patents.

The Jeffery patent, No. 607,245 of July 12, 1898, for Improvements in Pneumatic Tires and Processes of Making the Same, shows a further adaptation of metal spinning methods in the manufacture of pnuematic tires;



Jeffery Patent No. 602,245, (II-286).

and it is particularly interesting, because it illustrates in the same drawing a *manual* and also a *quasi mechanical* use of a disk-shaped roller, which is elsewhere throughout the record referred to as a "*spinning wheel,*" and sometimes as a "*stitching wheel.*"

The Seiberling and Stevens patent, No. 762,561 of June 14, 1904, for a Machine for Making Outer Casings for Double Tube Tires, illustrates and describes associated mechanisms for building automobile tires of exactly the same construction which is said to be the purpose of the State patent.

The pertinent parts of the Seiberling and Stevens machine are well set forth in Figs. 1, 4 and 6 of the drawings, and nothing need be added to the concise description which is contained in the opinion by Circuit Judge *Denison* of the Court of Appeals for the Sixth Circuit, in deciding *Firestone vs. Seiberling* (Pet. for Cert. pp. 24, 25), as follows:

> "The Seiberling and Stevens patent seems to disclose a machine for doing this work automatically, instead of manually. The machine comprised (so far as now necessary to mention): First, a main *power driven* shaft which would indirectly engage and drive the core and with such selective connections that the core could be revolved at *low speed* or at *high speed*, or entirely released, as desired; second, a reel carrying the rubber-impregnated fabric strip; third, a tension roller retarding the reel, and thus causing the central tread strip of the fabric to be given a *continuing* stretch after the free end is attached to the core; fourth, a presure roller or cylinder concaved on its exterior to match the shape of the tread of the core, whereby the tread portion of the strip was pressed upon and attached to the core as the latter revolved; fifth, an arm carrying,

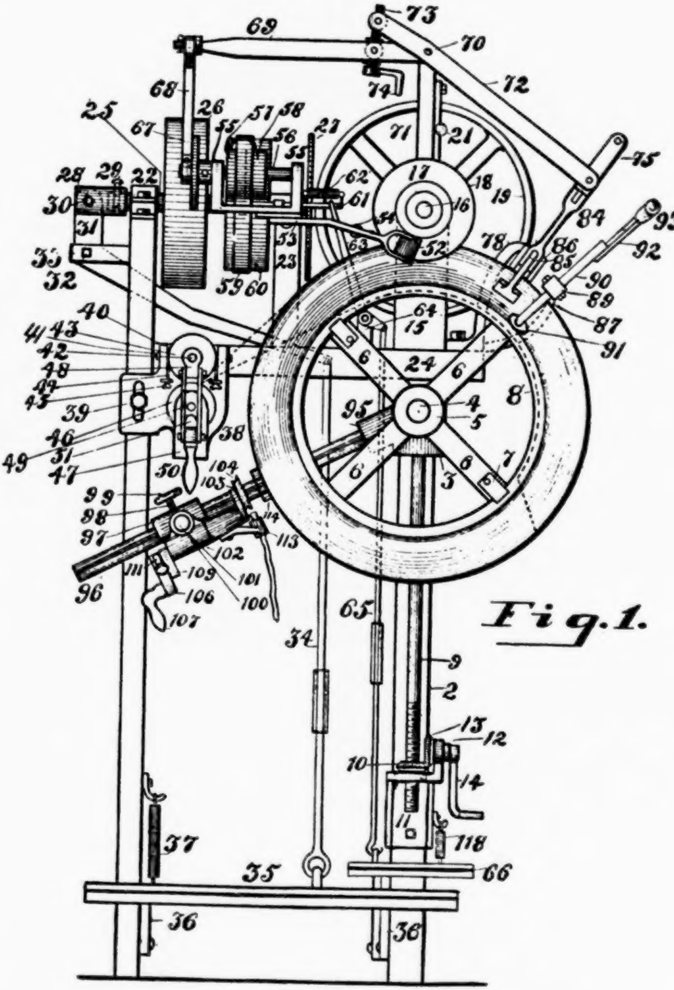


Fig. 1.

Seiberling and Stevens Patent No. 762,561 (II-257).

at its end, a laterally spring-pressed finger—'the jigger finger,' and which arm was intended to be reciprocated rapidly, radially of the core, in such a way that the finger traveled in and out radially, pressing against the side of the core as the latter revolved, and which pressure finger therefore traveled a saw-tooth course between the edge of the stretched, central, tread portion of the fabric and its final outer edge, and corresponded in function to the human finger pressing the fabric down against the core and stretching it into shape; sixth, a further arm containing a further *pressure wheel* to be applied along the edge of the attached fabric, after it was attached, to press it into a crease, constituting 'stitching.' "

The smoothing fingers 85 shown in Figs. 1 and 6 of this patent correspond in form and function to the *reciprocating paddles* referred to by witnesses in describing the so-called *"stitching method"* employed in building a tire by hand; and the sharp-edged rollers 91 shown in Figs. 1 and 4 of this patent correspond in form at least with the *spinning* or *stitching rolls* referred to by the same witnesses in describing the *"spinning method"* employed in building a tire by hand.

Under these circumstances, and in view of the early recognition in the Dewey patent of 1890 of the availability of either a *pressure paddle* or a *spinning wheel* for shaping a sheet upon a rapidly rotating form, and the common practice of so doing in the building of tires by hand; no invention would seem to be required to provide the *smoothing paddles* 85 with the *juxtaposed stitching rolls* 91 in the Seiberling and Stevens patent, and in radially reciprocating the same slowly enough to spin a fabric upon the core, if it were desired to do so.

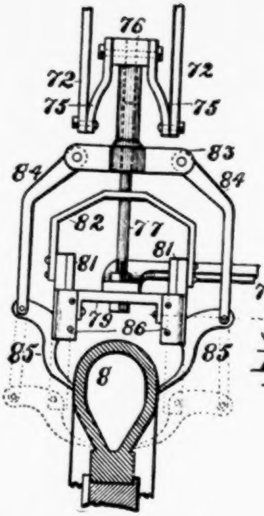


Fig. 6.

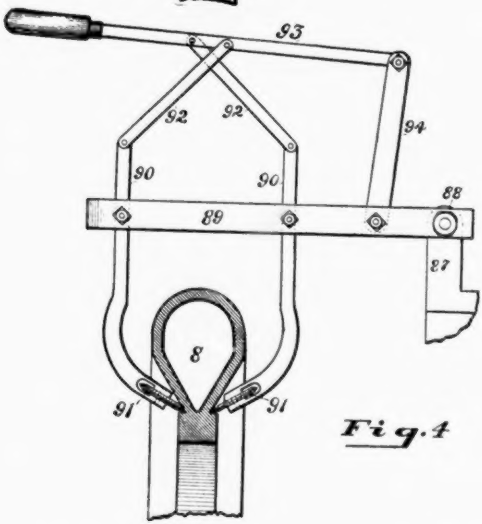


Fig. 4

Seiberling and Stevens Patent No. 762,561 (II-257).

The Vincent patent, No. 794,473 of July 11, 1905, illustrates and describes a machine for building tires, in many respects substantially the same as the machine of the State patent, including a power driven ring core, a stock roll or fabric supply and means for tensioning the fabric.

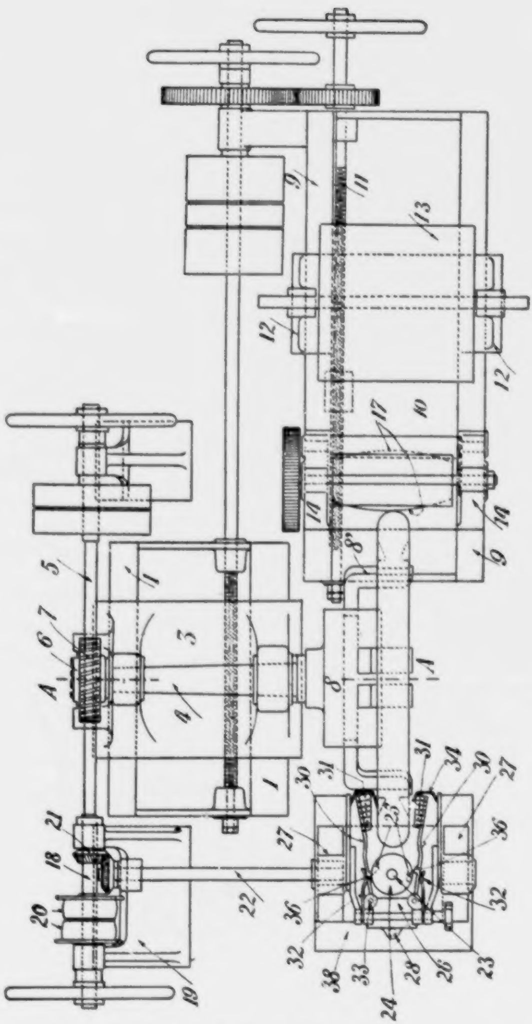
Although the machine of the Vincent patent may be intended more particularly for carrying out the so-called "single stretch" method, the testimony of Mell shows that when even an 18 or 20 per cent stretch or elongation is given to the fabric, it never lies on the core in correct position, and it is always necessary to place the fabric in its proper position by other means.

The machine of the Vincent patent was certainly a commercially successful machine, as evidenced by the report made in 1907 from Milan, Italy, by the plaintiff to his brother, that a Vincent machine was being there used to make four tires per hour, by a manufacturer who said that "*It works perfectly putting the fabric on at uniform tension*" (I-402); and as also shown by the testimony of *Harry K. Raymond*, of Akron, Ohio, Second Vice-President, in charge of production of The B. F. Goodrich Company, where a Vincent machine was used in about December, 1906, for a period of some eight months or possibly a year, "*In making between seventeen or eighteen thousand*" tires, which were "*commercial*" and were "*sold,*" and upon which *royalties* were paid (I-187, 8).

Upon cross examination, Mr. Raymond testified as follows:

> "XQ. 16. Did the machine operate satisfactorily with you?
> "A. It did.
> "XQ. 17. Entirely satisfactorily?
> "A. At that period of time, yes.

FIG. 2.



Vincent Patent No. 794,473.

"XQ. 18. You mean the tire standard was not, perhaps quite so exacting then as later on?

"A. Not at all that. I mean that machine was at that period a *perfectly satisfactory machine.* It was developed to produce more tires, at a less cost.

"XQ. 19. Were the tires of as good quality?

"A. They were.

"XQ. 20. Did you have any difficulty in the cam mechanism that operated the hammers, that you recall?

"A. No material difficulty, no.

"XQ. 21. But there were some imperfections in that action, were there not?

"A. I shouldn't say so. I don't think there was anything mechanical that couldn't have been cared for.

"XQ. 22. Were the original stretching devices for the fabric satisfactory in their mode of operation, as you recall it?

"A. I think so. *They made perfectly good tires*" (I-188, 9).

Raymond testified further that the percentage of circumferential stretch secured in the original Vincent machine was approximately about eighteen per cent, and proceeded to say that—

> "I think, Mr. Rogers, that the amount of stretch and the shape of the fabric on the Vincent machine conformed very closely to what is considered good practice to-day" (I-190).

Thus the Vincent machine, following the disclosure of the Seiberling and Stevens patent, left very little if any room in the rapidly narrowing field, to be occupied by subsequent inventors, having in mind the crowded state of the art shown by the prior practice and prior patents which have been reviewed.

MATHERN BELGIAN PATENT NO. 194,731.

September 20, 1906 (II-217).

The Mathern Belgian patent was granted during the year before State began his experiments, and seems to show everything which State has claimed, or could claim, in his subsequent patent No. 941,962 (I-1).

Copies of eighteen photographs, comprising Defendant's Exhibit D (I-162), illustrating a machine made and used under the Mathern German patent No. 206,-197, applied for December 20, 1906 (II-305), modified to include the rounded roller tools shown in Fig. 6 of the Belgian patent, together with reproductions of the drawings in the Mathern Belgian and German patents, are appended as a part of this brief, and reference is made to them in the following discussion.

Plaintiff's expert witness, Arthur S. Browne, has very fully and correctly described the machine of the Belgian patent, in setting forth the characteristics of the State machine for another purpose, as follows:

> "There is a rotating power driven ring-core. There is a low speed mechanism, a high speed mechanism, and speed changing mechanism, so that the ring-core may be power driven both at low speed and at high speed.
>
> "There is a stock roll for the unformed flat sheet fabric and tension mechanism between the stock roll and the ring-core, so that the sheet fabric can be uniformly stretched circumferentially when applied to the ring-core.
>
> "There are two forming- or spinning-rolls which simultaneously act upon the opposite sides of the ring-core and against the hinges of the sides of the fabric where the unattached portions join the attached portions.

"Each forming or spinning roll is carried by a swinging arm and is forcibly pressed against the fabric upon the core. (Mathern) gets this pressure by (manual) means * * *, and while the State patent shows a spring for this purpose, it specifically says that (manual means) may be used.

"The spinning rolls are mounted upon a sliding carriage. This sliding carriage is mechanically mounted and accurately guided upon the machine so as to move radially with respect to the ring-core.

"The sliding carriage is fed by a screw so that it is gradually and progressively advanced as the forming- or spinning-rolls press against the rapidly rotating ring-core.

"Each spinning-roll has a rounded working edge.

"Each spinning-roll is set at a receding angle with respect to the ring-core" (I-44, 5).

It is true that this analysis was made to apply to the Defendant's machine, but as it so clearly applies to the Mathern machine without any modification whatever, excepting only the substitution of the name "Mathern" for "Defendant," and of "manual means" for "a weight," both of which are within the specified scope of the State patent; no argument seems necessary to arrive at the conclusion that the Mathern patent completely anticipates the *machine* of the State patent, and this fact is necessarily implied from the disclaimer which has been filed in the Patent Office (I-9).

Plaintiff's disclaimer is obviously intended to avoid the effect of the existence of the prior Belgian patent, by pointing out certain things which it is said cannot be done by the use of the machine illustrated and described therein; in the face of the fact that few, if any, of these things are described or claimed in the State patent.

While it may not be fatal to the validity of the State patent, that it does not disclose or describe the manner in which it may *be operated* as outlined in the disclaimer, if the same is inherent in the machine which is set forth in the patent; it is no more fatal to the anticipating effect of the Belgian patent, that it does not disclose or describe the manner in which it may likewise be operated, if the same is inherent in the machine which is set forth in the patent. Obviously both patents must be interpreted by the same rule.

Plaintiff's Assumed Theory.

The disclaimer is based primarily upon an *assumed theory* that there is something inherent in the "*Slight uniform puckering of the fabric strips at their edges,*" normally produced by the Mathern machine, which is said to prevent the same from being applied to the sides of the core in the manner which is alleged to be inherent, although not set forth, in the State patent; and it is interesting, if not important, to consider what the record shows on this subject.

Plaintiff has sought to support this theory by the use in briefs below of an arbitrary or fanciful sketch, purporting to show the result of the slight crimping of the edges of the fabric by Mathern's beveled gears 36; and by the testimony of its expert Browne, as follows:

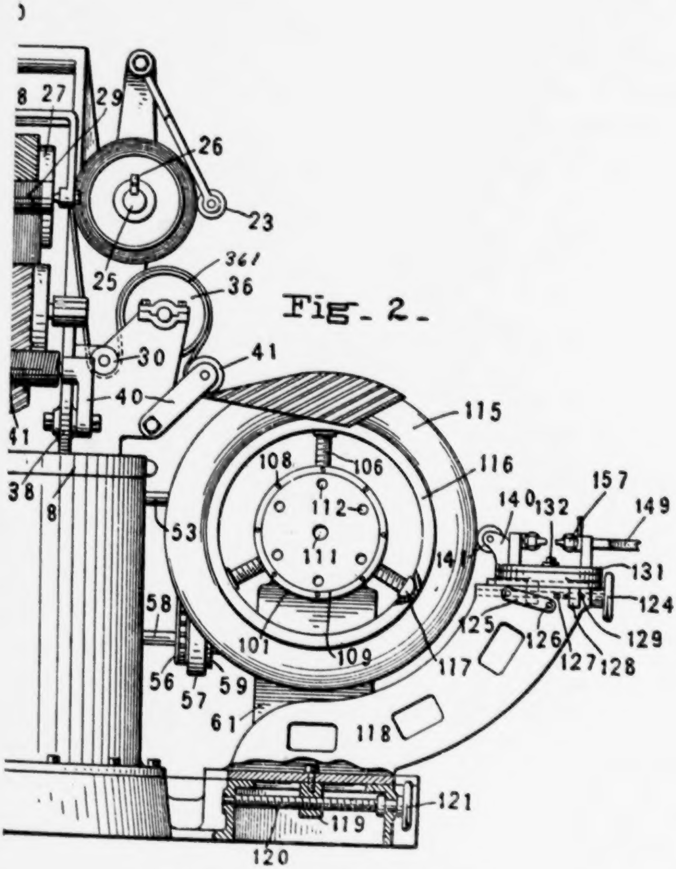
> "The described combined effect of the rolls 26 and gears 36 is to pre-form the fabric by stretching it at its middle and gathering it at its sides.
>
> "This pre-forming of the fabric would facilitate the subsequent sticking of it to the core, since it would be partly conformed to the shape of the core, and this is what Mathern specifies in his second claim as the purpose of this pre-formation" (I-462).

Aside from the slight crimping of the edges of the fabric, there is nothing materially different in the "preforming" of the fabric, by Mathern's longitudinal stretching operation, compared with State's corresponding stretching operation. In the Mathern machine, the fabric is passed over a spherical roller which stretches the median line of the fabric without stretching the lateral portions thereof, just the same as the median line of the fabric is stretched directly by the core of the State machine, without holding the lateral portions thereof to the stretch previously given thereto, which permits their elasticity to contract them to normal length at the sides of the core. This condition is clearly shown in Photographs Mathern Machine No. 6, *infra,* as compared with Fig. 2 of the State patent, on the opposite page.

In both cases the result is exactly the same when the fabric is initially applied to the core, the median portion of the fabric hugs around the tread portion of the core while the lateral portions of the fabric hang free of the sides of the core. This fact is conclusively shown by a mere inspection of the Plaintiff's Exhibit No. 35, Photographs State Machine (No. 1) (11-189), and of Defendant's Exhibit D—Photographs Mathern Machine (No. 7) *infra.* The latter picture shows that there is quite as much "bagging" of skirts of the fabric at the side of the tire in the Mathern machine as there is in the State machine, and that the slight crimping of the edges does not appreciably affect the position of the free fabric at the sides of the core.

There is no foundation whatever in the record for the sketch used in plaintiff's briefs, showing a tubular formation of the fabric with its crimped edges uniformly curved inward so as to initially embrace the sides of the core; and the impertinence of this sketch is evidenced by

the same Mathern picture, No. 7, which shows that the skirts of the core hang indifferently, and mostly swing outward away from the core, and do not embrace it as implied in the sketch referred to. Thus the *crimping* of the edges of the fabric is not a *pre-formation* thereof which materially affects the application of the fabric to the sides of the core.



State Patent No. 941,962.

Plaintiff further seeks to support the assumed theory, by urging that even though the lateral wings of the fabric are not formed and cemented to the sides of the core by the *initial stretching* application thereto, they *are so* applied and cemented to the core by action of Mathern's reciprocating rolls 30,—thus leaving no work for Mathern's spinning rolls, Fig. 6, to do, but to remove or eliminate the puckers or wrinkles *after* the fabric has been applied and cemented to the core, thereby preventing an operation on the skirts of the fabric when they are free.

Plaintiff's expert Browne is very careful not to testify directly that the reciprocating rolls 30 operate *all the way down* to the base of the core, but does so indirectly in describing the operation of the rollers, Fig. 6, as follows:

> "The function of the rolls 30, therefore, is to stick the fabric to *the straight or convex sides of the core* * that is to say, against the sides of the core whatever the shape may be, thereby cementing the sides of the fabric to the sides of the core" (I-463).
>
> "Thus, as the rolls 30 reciprocate back and forth in a direction which is radial with respect to the core, they bear on the sides of the fabric, pressing it against the core, and as a result the fabric is cemented to the core on its sides" (I-463,4).
>
> "The result of these actions up to this point is to lay and apply the fabric onto the core with wrinkles, folds, or puckers in it. Puckers, creases, or wrinkles have been intentionally made at the sides of the fabric by the conical gears 36 and wrinkles may exist in other portions of the fabric—inevitably so, if the spherical pre-forming rolls 26 shown in the drawings are employed" (I-464, 5).
>
> "Accordingly, Mathern then proceeds to remove the puckers or wrinkles from the fabric by the em-

* Emphasis Brown's.

> ployment of the tool shown in Fig. 6, or by employing two of such tools at the same time at opposite sides of the core" (I-465).
>
> "Thus the action of these rollers of the tools of Fig. 6, when two are employed simultaneously, is over the entire surface of the fabric, from the top of the core down to its base. Hence, wherever any puckers or wrinkles are located in the fabric, it is the intent of Mathern to remove them all by this comprehensive action of these tools" (I-465).
>
> "The sole office of the rollers of Fig. 6 which is mentioned in the Mathern specification is the removal or elimination of puckers or wrinkles which are present in the fabric *after it has been applied and cemented to the core*" (I-466).

The conclusion thus arrived at in the foregoing discussion, is not justified either by the plain language of the Mathern patent, or by an actual operation of the machine of the patent which is illustrated and described in the record.

In the first place, the Mathern patents describe the operation of the rollers 30 as follows:

> "Each of these rods carries at its extremity a roller 30, which advances and retracts on the core so as to stick to its *straight or convex* sides the fabric which has just been placed there" (II-220).

The juxtaposition of the words "straight" and "convex" is sufficient to show that both words are intended to refer to the *side portions of the core* as distinguished from the tread or base portions thereof; especially in view of the fact that the art at that time included cores which were either flattened or rounded on each side.

This fact is impressively shown by the disclosure of various figures in the Seiberling and Stevens patent

No. 762,561 (II-257), in which both kinds of cores are shown, and particularly in Fig. 5 of that patent, which illustrates a core with flat or "*straight*" sides as follows:

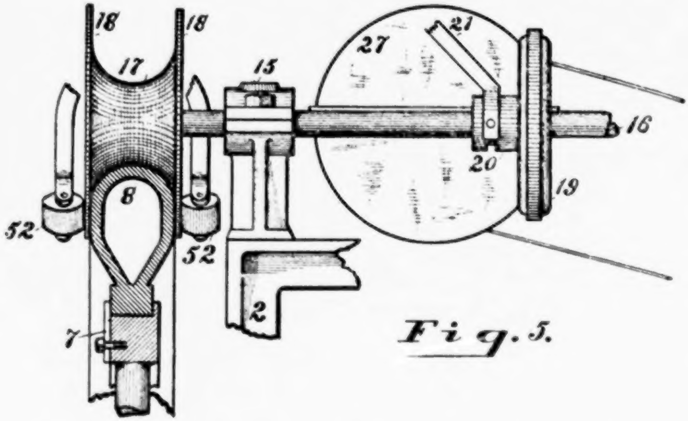


Fig. 5.

Seiberling and Stevens Patent No. 762,561 (II-257).

This illustration is also very impressive in showing the use of rolls 52 in cooperation with the disk flanges 18 on a tread roller 17, for pressing the fabric against the straight sides of the core, which is obviously the *sole* purpose for which the rollers 30 are to be employed in the machine of the Belgian patent; and which is the manner in which they are actually employed in the machine of Mathern's contemporaneous German patent, as well shown in Defendant's Exhibit D—Photographs Mathern Machine (Nos. 8 and 9) *infra*, with reference to a core having round or "convex" sides.

This conclusion is confirmed by the language employed by Mathern in describing the operation of his Fig. 6 spinning rolls, as follows:

> "Then the machine is set in operation and the roller is caused to descend progressively *on the side* of the core and *all the way down to its base*" (II-220).

There can be no mistake as to the meaning of this language, which occurs in the same paragraph of the Belgian patent in which the operation of the roller 30 is described by language which specifies only a particular portion of the sides, to-wit; the "*straight or convex*" portions thereof; so that Mathern's meaning is clearly conveyed by the use of language which cannot be mistaken.

And finally, it would be impossible to use a spinning roll to remove the wrinkles or puckers which have been produced by the crimping rolls in its edges, *after* they have been applied and cemented to the base sides of the core; or even to remove wrinkles which may exist in other portions of the fabric on the straight or convex sides of the core in the manner suggested by plaintiff's expert; for the reason that the testimony of practical men experienced in the art is that such wrinkles can only be removed by lifting the fabric from adhesion to the tire and smoothing it thereupon by the reciprocating use of a stitcher or a spade, as follows:

> "The only time that a saw-tooth movement of a stitcher or a spading tool need be used is when a wrinkle develops in the application by the spinning roll in the hand spinning which *necessitates lifting the fabric from the core* and straightening out the wrinkle" (Duncan I-199).

> "So far as I remember, wrinkles or uneven places obtained in stitching a tire were smoothed out by paddle or stitcher" (Roe I-170).

These considerations seem to dispose of the contention that the fabric is *applied and cemented* to the base sides of the core, either by the initial stretching opera-

tion, or by the action of the rolls 30 in the machine of the Mathern Belgian patent.

The same conclusion is clearly confirmed by further language of the Belgian patent, when read in the light of the meaning which is given to the terms employed therein, by the experienced tire builders whose testimony has been quoted at length in this brief.

Immediately following the description of the roller 30 and the roller Fig. 6 mechanisms, and the manner in which they operate, Mathern goes on to says that—

> "After the fabric has been thus *laid down by these devices*, the same operation is repeated in *laying down* the several fabric strips on which the beads are applied; then after the beads have been put on, the other fabric strips are *laid down* before covering and enclosing the beads. The *laying down* of these other fabric strips is accomplished in the same manner by means of the rollers 30 *and the roller tools like that shown in Fig. 6*" (II-221).

The expressions "laid down" and "laying down" are believed to describe the operation of *applying* and *cementing* the fabric to the core; that being the meaning of the same or similar expression used by each and all the experienced witnesses who have described the hand method of spinning tires.

In speaking of the operation of the hand spinning of the tires, Duncan said he "Would gradually move it *down* * * * until the fabric was completely *applied*" (I-194); Mell said that the fabric "Was rolled *down*" (I-153), and that it was "Worked *down*" (1-155); Koplin said they would "Stitch it *down*" (I-93); Drach said it was "Spun *down*" (I-102); Derry said they would "Spin it *down*" (I-108); Heller said he would "Spin it right *down*" (I-116); Stark speaks of "Running the ply *down*" (I-126); Green said he would "Stitch it *down*" (I-137); Gregg said he "Stitched it *down*" (I-148); Roe said it

was common practice "To stitch them *down*" (I-171); Bittaker said "The fabric was stitched *down*" (I-175); Curtis said they "Rolled it *down*" (I-294); Walch speaks of getting "Both sides *down*" (I-292); and finally, plaintiff's practical witness Mackey said they "Rolled the fabric *down* on the side of the core by a stitcher held in the hand of the operator" (I-116).

Thus every single witness who has told about building tires from personal experience, has used the word "down" to describe the operation of *applying* and *cementing* the fabric to the side of the core by a stitching wheel or a spinning roll; and it is fair to presume that Mathern well knew the common meaning of the word *down* among men familiar with the particular art, and that when he speaks of *laying down the fabric* by means of rollers 30, and the roller tools like Fig. 6, he meant the operation of *applying* and *cementing* the fabric to the core, as distinguished from a mere removal of wrinkles.

This conclusion is not affected by the language employed by Mathern in particularly pointing out the principle of his invention in his description and claim with respect to the operation of the spinning rolls, as follows:

> "The control systems of the several mechanisms may differ from those described above, but the invention comprises the application to the manufacture of tires * * * (c) of the principle of the roller descending progressively on the core during rapid rotation and producing a *progressive removal from the fabric of the puckers by eliminating the puckers from the point of their origin,* this being performed in a single descending movement" (II-221).

> "4. In a machine for mechanically manufacturing casings for pneumatic tires, as claimed in claim 1, a tool carrier having rollers and arranged to move downward automatically and progressively,

dependent on the rotation of the core, in order to *progressively efface the puckers of the successive strips of fabric* and to apply these strips on the beads, substantially as described and shown in the annexed drawing" (II-224).

In both of these statements, Mathern was no doubt endeavoring to *particularly point out* the essential characteristics of his *invention*, and distinguish the same from the things that were old and well known in the art, which was no doubt required by the Belgian law as it is by our Statute; and he was well advised in not including *broadly* in his principle and his claim, the operation of "*laying down*" the fabric on the core by means of his roller tools like Fig. 6, for he doubtless *knew that this principle and operation was well known and in common use in the art of spinning tires by hand*, before he devised his machine, and that *no one was entitled to a claim for the same.* For this reason Mathern could only *claim* the use of spinning rolls "*to progressively efface the puckers.*"

This understanding is confirmed, rather than refuted, by the fact that in stating his claim for the rollers 30, Mathern specified the use of the same as being "*to stick the fabric on the sides of the core*" (I-224); which he was fully justified in doing for the reason that, as far as this record shows, he was the first inventor in this art to use rollers having a reciprocating movement perpendicular to the axis of the core, while rolling radially thereon in the manner of the Belgian machine.

The nearest mechanical approach to this idea is embodied in the stitching fingers 85 shown in the Seiberling and Stevens patent *supra;* and although it may not have involved invention to provide these fingers with the *old* hand stitching *disk* rolls traveling *along* the core,

if there *was* any invention involved in providing the same fingers with *cylindric* rolls traveling *across* the sides of the core, Mathern *was entitled to include and claim it as his invention.*

Thus the result is naturally reached that the rollers of Fig. 6 in the Belgian patent are intended by Mathern for "*laying down*" the fabric on the base sides of the core, from a position in which the wings of the fabric *stand free of the core;* as well illustrated in Photographs Mathern Machine, No. 9, *infra*, which shows the fabric on the core *after it has been acted upon by the rollers 30,* in position to be acted upon by the rollers of Fig. 6; and that in conjunction with the *old* spinning operation of "*laying down*" the fabric, Mathern's spinning rolls performed the additional function of "*progressively effacing the puckers.*"

Operation of Mathern's Spinning Rolls.

It does not seem necessary to discuss or determine whether Mathern's spinning rolls were intended to act on any portion of the *tread or top surface* of the fabric, as suggested by plaintiff's expert Browne (I-465); for the reason that if they do so operate, they merely perform a function which is attributed to the spinning rolls of the State patent, which are said by State in his patent to operate, as follows:

> "At first the spinning-rolls are positioned to act upon the edges of the tread portion of the tire-shoe" (I-21).

At any event the Belgian patent only specified that each Fig. 6 roll "*Is caused to descend progressively on the side of the core and all the way down to its base*" (II-220).

Plaintiff's expert Browne, however, seems to think that the spinning rolls of the Belgian patent are not mechanically fed and controlled in the same manner as they are fed or controlled in the State patent, as follows:

> "It is hence evident that by reason of its open hook embracing a pin 35, the tool of Fig. 6 is neither automatically nor positively fed downward.
>
> "For example, if the workman who has hold of the tool handle keeps the tool in a definite vertical position, the tool carrier slide will feed downwardly without imparting any feed at all to the tool and would ultimately feed down far enough to remove entirely the lateral pin 35 from the open hook of the tool. *The workman himself must perform the act of feeding the tool downward.* The only function of the slide 17 and its pin 35 with respect to the feed of the tool is that it prevents the workman feeding the tool down too fast. The tool cannot slip in the hands of the workman and go down too far. But the progressive and gradual radial advance of the tool, while limited by the tool carrier, *is due solely to the conscious act of the workman.* The workman, therefore, must feed the tool ahead at the same time that he is pressing its roller against the fabric, and is preventing the tool from being tilted in the plane of the core's rotation" (I-470, 1).

In giving this opinion Browne seems to have overlooked the testimony given by State himself, to the effect that the action of a spinning core is to *draw a spinning tool* applied to the sides thereof *inward toward the center* of the core, as follows:

> "Q. 129. And how did this system of advancing the slide 'M' work out in practice?
>
> "A. The tendency was to *lead in quickly,* and at times *was hard to hold.*
>
> "Q. 130. Why was it hard to hold?
>
> "A. From the tendency to *lead*—or for the rolls to *draw it in.*

"Q. 131. You mean that the *contact of the rolls* with the fabric on the core *tended to pull the slide in?*

"A. Yes.

"Q. 132. What was the reason for this tendency?

"A. In starting it on, *it seemed to take a screw movement in the rolls,* not advancing evenly on the side of the fabric; and, after they had started that way, they would continue.

"Q. 133. You mean that it was difficult for the operator to advance the slide toward the core regularly?

"A. Yes.

"Q. 134. Because the contact of the rolls with the side of the core *tended to pull the slide in?*

"A. It did.

"Q. 135. And, therefore, it was not easy to get a uniform advance of the rolls; is that correct?

"A. Yes.

"Q. 136. I next hand you, 'Sketch 8,' and ask you to point out the difference therein over 'Sketch 7^b.'

"A. Instead of operating the slide with a lever, it was operated with a screw and hand-wheel. In the hand-wheel you were able to change the position of the handle into different holes, so the operator could be able to change the speed of advancement.

"Q. 137. Now, did this device, particularly referring to the screw-feed of the slide, overcome the difficulty you have testified to in connection with 'Sketch 7^b,' as to which you stated that there was a tendency, because of the engagement of the rolls with the core, to draw the slide in by itself?

"A. It did.

"Q. 138. Just how and why was that tendency overcome in connection with the screw-feed?

"A. *The screw would not allow it to do it,* held it back.

"Q. 139. In other words, then, the screw had two functions: it enabled the operator to advance

and retract the slide at will, and, moreover, *resisted the tendency of the rolls to pull the slide in;* is that correct?

"A. Yes." (I-318, 19, 20)

Mathern evidently understood the tendency which State claims to have discovered, and depended upon the same to *draw the rolls inward* during the spinning operation; and as State testified that the tendency was so strong that it was hard to hold manually, it is evident that Browne was not well advised in testifying that the gradual radial advance of the spinning roll is *due solely* to the conscious act of the workman. As a matter of fact the spinning rolls are *automatically drawn inward,* when they are pressed against the side of the core.

Thus the *"'open hook"* connection of the Mathern spinning rolls with their support is sufficient to cause the rolls to operate in exactly the same manner that the State spinning rolls are said to act, because the *inward drawing* action resulting from their pressing contact with the core, tends to draw them inward just as fast as the screw feed will permit; the screw feed being employed by State as well as by Mathern, not to move the rolls inward while they are in action, *but to restrain too rapid an inward movement thereof.*

Therefore, if any invention was involved in providing a screw-fed sliding support for spinning rolls in a tire building machine, *Mathern anticipated State* in doing so.

Amount of Pressure Required.

Plaintiff's proofs do not sustain the position that the Belgian machine is ineffective for the work of properly building a tire, because its mechanically mounted and radially fed spinning rolls are not provided with springs to press them toward the core.

On the contrary, the record shows that a spring pressure is only useful for the purpose of constantly holding the spinning rolls against the side of the core, and to relieve the workman of a portion of the energy required in giving the full and varying pressure required, which is always supplied and controlled by the hands of the workman, in machine work as well as in hand work.

State candidly admits that tires can be well made if the stitcher arm is pressed in only by the strength of the operator and no spring used, as follows: "*You could have pressed it in hard enough to have made a tire that would have been all right * * * without the use of a spring*" (I-376); and tells why springs are not in themselves sufficient for the purpose, as follows:

> "The springs naturally—all the springs that were used naturally weren't as active as directly on the rolls when the core got narrower than when they were on the ball of the core, when *they would add a little pressure by the hand to it*" (I-377).
>
> "Along the tongue of the core, where it was thin, they *could help out the pressing on by spreading* (the stitcher arms) *with your hands*" (I-32).

And plaintiff's expert Browne admits that spring pressure is not uniform, as follows:

> "XQ. 78. You have referred to the spinning rolls 147 as being pressed inwardly by springs or by weights. If the said rolls are pressed inwardly by springs is it a fact that the pressure exerted by the said springs, and hence by the rolls, upon the fabric, *becomes less as the said rolls progress from the point of extreme width of the core toward the inner periphery of the core?*
>
> "A. Yes."

This testimony means that spring pressure becomes *weaker* as the spinning wheels approach the base of the

core where the *greatest pressure* must be applied to give the *increased radial stretch* required at the bead edge of the fabric; and that there is a like *lack of uniformity* in the pressure of springs which there may be in a purely manual pressure. In both cases, the required amount of pressure must be supplied or controlled *by the strength and will of the operator;* and many of the experienced tire builders have testified that their unaided strength is *fully adequate* for the work required.

Duncan points out that—

> "The amount of side pressure need be only sufficient to apply the fabric smoothly. The *adhesion* is obtained during the molding operation" (I-203).

Mell explains the molding operation as follows:

> "The tire was then *cured* in the usual manner, that all full molded tires are cured in" (I-154).

Koplin testified that the pressure in Firestone machines—"*Isn't any more than a man can use* * * * about 30 or 40 lbs." (I-198, 9) and Stark says "*I always got enough* on there to get them down where they should be" (I-128).

Walch testified that "*The hand made tire was considered just as good as far as durability goes as a machine made tire*" (I-288); and explained that the *amount of pressure* was not so important as it was to *hold the stitcher steady* as follows:

> "Well, it was not a *great pressure*—just enough to stick the fabric to the cement; there was some on the inside, just to touch the fabric, very little pressure * * * not to amount to anything; *you had to hold the stitcher steady;* that is the way you held it, the pressure, you didn't have to put on much pressure at all" (I-290).

It being shown that hand pressure is *fully adequate* in the use of spinning rolls for building tires, the Mathern patent discloses a machine which is *entirely effective* for the purpose intended; and if it is desirable to use springs to supplement manual control or pressure, the early Seymour patent No. 80,836, *supra, completely anticipates* State in the use of springs for the identical purpose.

Action of Centrifugal Force.

The machine of the Belgian patent is provided with clutches and gears for rotating the core alternately at high and low speeds. In describing the operation of the spinning rollers shown in Fig. 6, the patent specifies: *The principle of the roller descending progressively on the core during rapid rotation*" (II-221); and in claim 4 of the patent is specified "*A tool carrier having rollers and arranged to move downward automatically and progressively, dependent on the rotation of the core*" (II-224).

Furthermore Mathern's claim 4 refers back to his claim 1, which reads as follows:

> "In a machine for mechanically manufacturing casings for pneumatic tires, characterized by the fact that *several gears and clutches impart to an annular core various rotations appropriate to the phases of the manufacture* and enable the employment of special devices constituting part of the machine, substantially as described and shown in the annexed drawing" (II-223).

Thus the Belgian machine is provided with mechanical means for operating its core at a *slow speed* for stretching the middle or tread portion of a fabric, and for then operating it at a *fast speed* for spinning the fabric down upon the sides of the core, in *exactly the same manner* which is portrayed in the State patent.

Plaintiff's theory of the Belgian patent, seems to include a further assumption that the presence of slight uniform puckers in the fabric strips along their edges, serves to prevent these portions of the fabric from being thrown out by the rotation of the core in the same manner the corresponding portions of the fabric are thrown out by the rotation of a core in the hand method of building tires, and are said to be thrown out by the State machine.

This assumption is quite as gratuitous as the idea that the crimped edge portions of the fabric are intended to be and are attached to the corresponding sides of the core, either by the initial application of the stretched fabric or by the action of the reciprocating rolls 30; and no reason is seen why the unattached skirts will not be thrown outward by centrifugal force during the rapid operation of the Mathern core, just exactly the same as they are thrown out by a corresponding operation of the State core.

It is quite clear that such will be the action of the fabric when the spinning rolls are riding upon a portion thereof which has not been crimped, and it is only necessary to consider the action of the spinning rolls when they reach the crimped edge zone of the fabric.

The specification of the Belgian patent is not silent on this subject, for it expressly describes the principle of this particular operation of the machine as being—

> "The roller descending progressively on the core during rapid rotation and producing a progressing removal from the fabric of the puckers by eliminating the puckers *from the point of their origin*" (I-221).

This language can only mean one thing, and that is that Mathern's spinning rolls act upon the inner ends of

the slight uniform puckers to progressively eliminate them, just the same as State's spinning rolls operate on the inner ends of larger irregular puckers, to progressively eliminate the same.

The action of the spinning rolls produces a pressure line on the fabric in the path of its travel, along which line all the puckers in the fabric have been entirely eliminated and as the roller gradually progresses inward along its spiral course, this line continues to mark the inner ends of the puckers, which is the "*point of their origin*" referred to in the Mathern patent.

Furthermore, as the fabric is always laid smoothly along this line, it constitutes a hinge line upon which the outer unattached portion of the fabric may be thrown out by centrifugal force as readily as though it were not crimped with a slight uniform puckering.

An inspection of Defendant's Exhibit D—Pictures Mathern Machine, especially of pictures Nos. 9, 10, 11 and 12 *infra,* serves to show that such is and must be the operation of the machine of the Belgian patent; which is confirmed by pictures Nos. 12 and 17, which show the fabric to be smoothly applied, without any wrinkles, all the way down to the cutting line of the core.

In considering these pictures, it must be remembered that they are taken while the machine is not in motion, just the same as Plaintiff's Exhibit No. 35—Photographs State Machines, are taken while that machine is not in motion; so that in none of the pictures is the unattached skirt of the fabric shown to be thrown outward by centrifugal force as would be shown if motion pictures were taken of the respective machines.

Thus the machine of the Belgian patent can operate, and actually does operate in exactly the same manner as

the machine of the State patent; and if the identical operation produces a sufficient radial extension of the fabric to carry out the double stretch method of building tires in the one machine, it must necessarily produce at least as much radial stretch in the other machine.

That the Mathern machine of the Belgian patent, Defendant's Exhibit H (I-242), shown in Defendant's Exhibit D—Photographs Mathern Machine, *infra,* does so operate, is evidenced by the testimony of *John W. Thomas* that the machine was actually operated at the Firestone plant for making tires which were actually used on automobiles with satisfactory results (I-160); and by the testimony of *Guy L. Evans* that the machine was not only then used at the Firestone plant, but that he was one of the men who *operated that machine before the judges* of the Circuit Court of Appeals, at Cincinnati (I-165).

As a matter of fact, it would seem that the crimped zone in the edges of the fabric produced by the Mathern machine, might serve to *increase* the friction caused by the engagement of the outthrown skirts around the edges of the spinning wheels of the fabric, over that caused by the plainer skirts in the State machine; and to this extent, the operation of the Mathern machine would give a *better* result than that of the State machine, although the better result would be inclusive of the *lesser* result in its anticipating effect.

It may be noted that the Belgian patent says nothing about the action of centrifugal force and the radial stretch which are attributed by way of disclaimer, to be inherent in the State patent machine; and if this omission were a matter of consequence, it is just as true of the State patent, wherein the only reference to *cen-*

trifugal force is that it "tends to throw the fabric out at right angles from the core-plane and unless the roller recedes in the manner shown, ***the fabric will become entangled with it***" (I-20)—no reference whatever being made to a ***resulting radial stretch.***

This fact has caused Circuit Judge ***Denison*** to point out that ***"Centrifugal force is not mentioned, in State's specification, save as creating an obstacle to be avoided";*** and it is quite as important to point out that the same obstacle was met and overcome in spinning down fabric by hand, not only by a 45° receding inclination of the stitching roll, but by the use of a roll having a larger diameter. Testimony to this effect was given by Duncan, as follows:

> "The fabric stood out at approximately right angles to the plane of the core. The roller was applied to the fabric on the core at approximately *an angle of forty-five degrees* to the plane of the core" (I-195).
>
> "A small wheel would have a tendency to *let the skirt of fabric catch the supporting yoke* and jerk it out of position. * * * The first wheels were about an inch in diameter but were almost *immediately increased* from two to two and a half inches. * * * The smaller ones were abandoned" (I-201).

It is more important, however, to point out that the state of the art shown by the prior practice testimony, gives the best explanation of the failure of both Mathern and State to describe the action of centrifugal force and the use of a radial stretch in the skirts of the fabric, when they are *"laid down"* on the sides of the core; is that this *action* and this *stretch* was so well known by the hand method workers, that no description of either the action or the stretch was *necessary* to enable men skilled

in the art to properly and successfully operate the respective machines.

The same thing is true of Mathern's failure to mention the numerical rate of the rapid rotation of the core required for the spinning process, which was *too well known* to require any description thereof; and State's guess on this subject, "*say at two hundred and seven times a minute*" (II-16), only confirms his testimony that in 1908 he *could not tell* within 50 revolutions the most desirable high speed for the core (I-375), and that he did not determine the high speed himself—and did not know who did (I-376).

State's guess was at least one hundred revolutions per minute and some 100% more than the speed of Goodyear commercial machines, in which the centrifugal force is utilized to good advantage, to-wit: "*somewhere between 80 r. p. m. and 120 r. p. m.*" as shown by the testimony of plaintiff's expert Browne, as follows:

> "XQ. 95. Then is it your understanding of the language I have quoted from the disclaimer that the unapplied fabric is thrown out to a position substantially at right angles to the plane of the core by centrifugal force?
>
> "A. I think this would be the case if the centrifugal force was being used to the best advantage. My observation is that the skirts are *thrown out at substantially right angles* to the plane of the core when a 34 x 4 core is rotating at about 80 r. p. m., but at that speed the skirts are not smooth, but still present waves or corrugations. These waves or corrugations disappear, however, at a higher speed, such as that employed in the Goodyear commercial machines and the centrifugal force is then utilized to good advantage.

"XQ. 96. You mean the thrown-out portions of the fabric will be smooth at a speed of about 120 to 150 r. p. m. Is that correct?

"A. They are smooth at that speed and *become so somewhere between* 80 r. p. m. and 120 r. p. m." (I-68).

Browne's testimony that the *"skirts are thrown out at substantially right angles to the plane of the core * * * when rotating at about 80 r. p. m.,"* brings State's so-called "high speed" down to or within the prior hand-spinning practice, and shows that State's alleged discovery was merely one of *degree*, and not of *kind*. At any event, State's testimony shows that if any discovery was made along this line, *he did not make* it and *does not know who did.* Furthermore the point is not sufficiently defined in the State patent to sustain a claim, either for a *method* or for a *mode of operation.*

These final considerations further confirm the conclusion reached above, that the mechanical means set forth in the Mathern Belgian patent are not only *adapted* but are *intended* to carry out the prior-practice hand-method of building tires, and to accomplish the same result by the *identical* mode of operation which is said to be inherent in the machine of the State patent; and that, therefore, *the Belgian patent in itself*, completely anticipates the State patent, not only with respect to the machine disclosed therein, but with respect to the *method* as well as the *mode of operation* said to be inherent therein.

RADIAL STRETCH THEORY.

Although the deciding judges in the Circuit Court of Appeals for the Third Circuit, seem to concede the prior practice of the *double-stretch* and *roll-spinning* meth-

od of building tires by hand, their decision appears to be founded on the idea that the operation of the State machine is something *wholly different* from the original hand process; and it is difficult to reconcile the seemingly divergent statements on this point in the opinion by Circuit Judge *Buffington*, as follows:

> "Leaving aside the tires made by a single stretch of fibrous material, and which were forced into place on the side of the shoe by what are known as "jigger fingers," and confining ourselves to shoes in which the material is stretched at different parts of the shoe in two directions at right angles to each other, and to a process of cementing or plastering them in place by a spinning roll, *we note the fact that tires embodying these two features of double stretch* and *roll-spinning fastening, were before the patent to State here in question, handmade*" (II-404).
>
> "Far from being separated, isolated zone processes, there is a gradual and uniform, and indeed an unbroken spiral sequence caused by the rapid rotation of the core and the consequent exercise of the centrifugal force on the covering material, by which it is *automatically* gradually *stretched radially* and by the joint action of *such centrifugal, radial stretch*, and the spinning rolls, the square of the median zone progressively shades into the radial diamond shaped interstices of the bead or inner zone of the shoe. In a way we have anticipated what State's machine really is, by thus describing its results. But such statement should be initially made, for the *crux and dominating functional feature* of State's machine is the use upon the fabric of a centrifugal force caused by rapid rotation, *a process which is wholly different from the original hand process.*" (II-401,

It is very difficult to see wherein there is anything "*wholly different*" in the "*use upon the fabric of a cen-*

trifugal force caused by rapid rotation," from the "*double stretch roll-spinning fastening*" which was used in the prior practice; unless it be the *rate* of such rapid rotation, which is obviously a matter of *degree* and not of *kind*, and was inherent in the Mathern machine, or perchance the so-called *automatic graduation of the radial stretch*, which was likewise inherent in the Mathern machine.

Upon a showing less complete as to the prior practice, but *with machines in actual operation before them*, which does not appear to be the case in the Third Circuit, the judges in the Circuit Court of Appeals for the Sixth Circuit reached a diametrically opposite conclusion, in the opinion by Circuit Judge *Denison*, as follows:

> "Plaintiff really presents his case on the theory that State discovered a *new method* of making tire casings or a new set of functions to be performed by associated mechanism" (Pet. for Cert. p. 35).
>
> "We prefer to point out also that State had nothing broadly new either in his *method* or in his *selected tools*" (*Ibid.* 35).
>
> "The evidence that this *identical spinning operation* was performed upon tire casings by hand tools before State's invention is sufficiently satisfying to meet all the requirements of the situation" (*Ibid.* 36).
>
> "The Belgian tool in its radial progress was *bound to stretch and reshape* the fabric in substantially the same way that is done by State. Putting all these things together, State cannot be considered as the inventor of the *method*" (*Ibid.* 38, 9).
>
> "We are told that the centrifugal force disclosed by State's operation caused the unattached skirts of the fabric to fly out at right-angles to the plane of the core, and that the effect of the spinning tool slowly advancing against this skirt was to

produce a 'hinging and folding action' which was novel and important. *We are not impressed by this claim.* These words do not seem very appropriately descriptive, but the action which takes place not only pertains to a *method* or *process* rather than to any particular mechanism, but it was more or less *inherent in the rapid revolution of the core effected by older means,* and in the use of any spinning, stitching or creasing rollers" (*Ibid.* 42, 43).

"Perfectly successful spinning *performed in court,* upon a slowly revolving core, demonstrates that the outflying skirts are *not essential.* To make centrifugal force an effective basis of validity in the State patent would be to give a monopoly of the spinning *process* or of *rapid core rotation;* and *each was old*" (*Ibid.* 43).

The fact that slowly-revolving spinning-operations performed in court, demonstrates that the outflying skirts are not essential, and the further fact that the prior spinning practice produced *hand made* tires quite as good as *machine made* tires, upon cores rotating at very little if any less speed than is said to be effective in the State machine; naturally suggests that there must be something wrong with the theory that centrifugal force is the controlling factor in effecting this radial stretch in the unattached skirts of the fabric.

Obviously, the facts do not fit the theory, for the reason that when the alleged action of centrifugal force is most needed, there is less of it available for effective action. The maximum width of the unattached fabric to be acted upon extends outward from the neutral zone at the side of the core, and as the spinning operations gradually applies the skirt to the core, there is a corresponding gradual decrease in the width of the unattached fabric to be acted upon by centrifugal force, until it is re-

duced to a minimum, or vanishes to nothing at the base of the core.

The requirements of the radial stretch operation, however, demand that the force applied shall *increase* from a *minimum* at the neutral zone on the side of the tire, to a *maximum* at the base of the tire; and if the action of centrifugal force is depended upon for this purpose, it gradually vanishes to nothing when it is most needed.

The beneficial function of centrifugal force would rather seem to be the action of throwing the fabric outward into a cylindric form so as to circumferentially stretch out the large baggy folds which would otherwise hang from the line of attachment; thus leaving the spinning rolls free for the work of radially stretching the fabric as it is gradually applied to the core, by the frictional contact of the edge of the roll by its direct pressure on the fabric *as it is positively backed by the core.*

There is support for this view in the testimony of plaintiff's expert Browne, as follows:

> "My observation is that the skirts are thrown out at substantially right angles to the plane of the core * * * at about 80 r. p. m., but at that point the skirts *are not smooth*, but still present *waves or corrugations.* These waves or corrugations *disappear*, however, at a higher speed, such as that employed in the Goodyear commercial machine and the centrifugal force is then *utilized to good advantage.*"

Thus the "*good advantage*" which is said to result from the action of centrifugal force would appear to be the elimination of the baggy condition of the fabric; and the relatively *slight* pressure which the outthrown fabric may exert at the edge of the spinning roll, as compared with the *positive* resistance of the core to the pressure of

the spinning roll, would not seem to materially affect the radial stretching action thereof.

At any event, the frictional contact would be limited to the extreme peripheral edge of the spinning roll, because the cylindrical skirt could not be *circumferentially* stretched enough to cause it to fold or wrap around the edge of the roll in the manner suggested on behalf of the plaintiff.

There is further support for this view in the testimony of Derry, as follows:

> XQ. 48. Why did you want to give it so high a velocity?
>
> A. To make your number a good deal easier, to get the speed to pull the fabric down. Run it on low speed, wouldn't flare out; on high speed, it would flare out.
>
> XQ. 49. Why did you want it to flare out?
>
> A. So the fabric *wouldn't wrinkle.*

According to this witness, the principal purpose of throwing the fabric out was to avoid wrinkles, and it is obvious that when the unattached skirt is once thrown *straight out*, by the speed employed in the hand practice, it assumes the position of an endless band attached at one side to the core, which would prevent any further radial movement outward without a *circumferential stretching* of the fabric. In other words, when the fabric skirts are thrown out *straight*, as in the hand practice, the benefit of any increased action of centrifugal force would seem to be negligible.

The baggy waves or corrugations in the unattached fabric clearly appears in Plaintiff's Exhibit No. 35—Photographs State Machine, Nos. 1 and 2 (II-189, 91), and in Defendant's Exhibit D—Photograph Mathern Machine, Nos. 5, 7, 8, 9, 10, 11, 14, 15, and 16, *infra;* and the latter pictures show that the slightly crimped zone which

may be produced in the edge of the fabric by the Mathern machine, does not materially affect the baggy condition of the unattached skirts, shown for a plain edge in picture No. 18.

The conclusion is therefore compelling that, after giving full effect to the disclaimer of record, there is nothing left of the State patent save a series of directions for the use of the admittedly old mechanical combinations; which directions merely describe a manner or mode of *operating* the State *machine*, to perform the same *functions* for shaping, spinning and radially stretching fabrics, by the same *method* or mode of *operation*, which the deciding judges in the Third Circuit *conceded to be old* in their preliminary finding of facts, quoted above.

STATE PATENT No. 941,962.

The operation of machines said to embody the invention of the State patent, was exhibited to defendant's expert, Frank N. Waterman, at the Goodyear factory by plaintiff's Counsel, and his expert Mr. Ray; and the operation of these machines is well described by Mr. Waterman, and serves to confirm many of the conclusions which have been reached on other grounds, as follows:

> "The high speed was 120 R. P. M. instead of 207" (I-231).
>
> "The machines shown me were not all alike, but the arrangement in each case was such that *the spring played little or no part in the operation*, the pressure being as I judged practically wholly applied by the operator leaning heavily against this handle while performing the spinning operation. In other words, the operator appeared to be making

fully as much physical effort in this spinning operation as in the cases where I have seen the spinning operation performed by hand'' (I-232).

"The spinning rolls appeared relatively larger than is indicated in the State patent and they acted under the heavy pressure applied by the operator against the core as in ordinary hand spinning and * * * did manifestly compress or pinch the fabric between the roll edges and the core precisely as in hand spinning; and this was evidenced when the spinning was completed by the *pressure line left on the fabric which showed the path of travel of the spinning roll.* * * * Such a line is left by the hand spinning roll as used in the hand spinning as I saw it in use many years ago'' (I-232, 3).

"The work which I saw was not as the patent says (page 7, line 49) 'better than they can be made by hand,' but was *extremely poor, much worse* than I remember having seen it done by hand and indeed *the faults of the machine had to be remedied by hand* both while the core was attached to the machine and after it had been removed therefrom.

"In practically every layer of fabric applied very large and very bad wrinkles were formed and *it was necessary to stop the machine and lift up the fabric and smooth it down by hand with a spade,* after having applied cement underneath in some instances'' (I-233).

It goes without saying that the demonstration given to defendant's expert by plaintiff's counsel and plaintiff's expert, was undoubtedly carried out under the most favorable circumstances and conditions to present the best operation of State's machine, and the foregoing testimony shows that these machines are subject to substantially the same difficulties which are said to be inherent in the operation of spinning tires by hand.

It might be assumed *a priori*, that a machine made tire would not be as perfectly formed or wear so well as a hand-made tire, because of the intimate attention to all the details which must be given by the manual worker, just the same as watches, shoes, and all kinds of wearing apparel are always known to be better made by *hand* than by *machine;* and the record here shows that hand-made tires are *just as good,* if not better, than machine made, tires even though they are made by a machine under the State patent.

It only remains to repeat that the *method* carried out by the State machine is anticipated in every material respect by the prior hand practice and also by the operation of the Mathern Belgian machine, and that the *machine* of the State patent as well as its *mode of operation,* are both anticipated by the machine and mode of operation of the Mathern Belgian patent; and that in each case the anticipation goes to each and every limitation and every condition which has been imposed upon the claims of the State patent by the disclaimer of record.

METHOD AND MODE OF OPERATION.

The undisputed facts here present are believed to lead so naturally to the foregoing conclusions, that the same need only be stated to readily come within the established principles of patent law, which will naturally suggest themselves to the Court without the need of citing the authorities herein.

If it should be urged, however, that the foregoing conclusions are not correct, they are believed to come fully within the reasoning of Robinson, so well set forth in the note to Section 172 of his Treatise on the Law of Patents, as follows:

"Where a process consists entirely in the operation of a machine or other instrument, it approaches so nearly to the function of the instrument employed that several decisions have been rendered identifying it therewith, and hence denying its patentability.

"But the process and the function are, after all, two entirely separate entities, both in intellectual and physical contemplation; the former being capable of conception apart from any object acted on, the latter not so.

"The difficulty is another form of the old confusion between the end and the means, and is to be avoided by defining sharply the end to be accomplished, and determinnig whether the machine or the operation performed by it is the actual means.

"For if the operation performed by the machine is new in reference to the object upon which it is employed, a new process has been invented; and this is no less true if the machine or instrument employed is new than if it were old, or if the process can be performed in no other known way than by this particular machine.

"While, on the other hand, *if the operation is known in reference to the object*, the invention of a new machine for performing it does not make a new process, but only a *new instrument* for applying it."

"Whether or not a new machine is the reduction to practice of a new process, or is a new instrument for the performance of an old process, is, therefore, *to be determined by the state of the art* at the date of the invention.

"If it is the former, the process is patentable, though the machine be new. If the latter, *only the machine can be allowed the protection of the law.*"

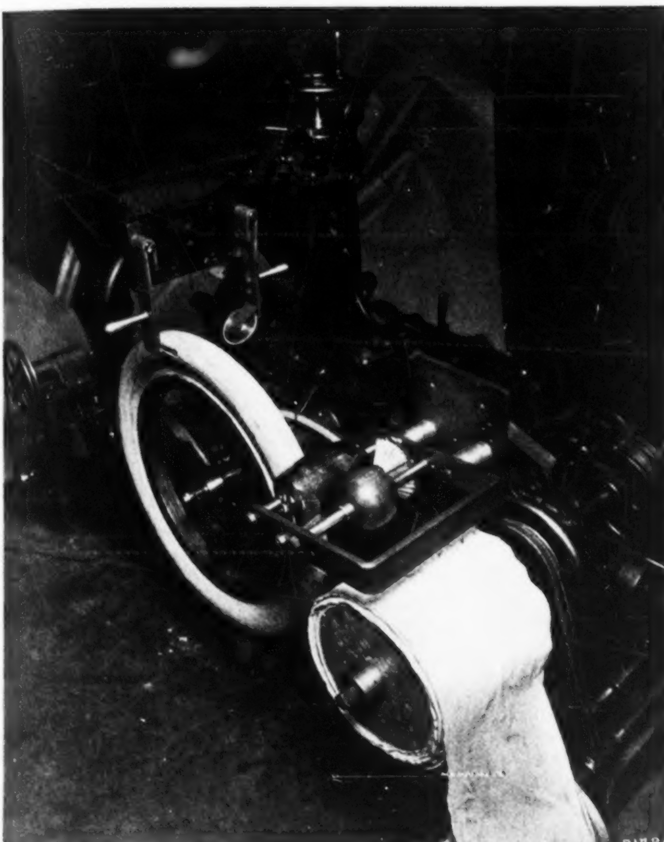
The application of these principles to the present case is so obvious, as to render argument superfluous.

Respectfully submitted,

HARRY FREASE,

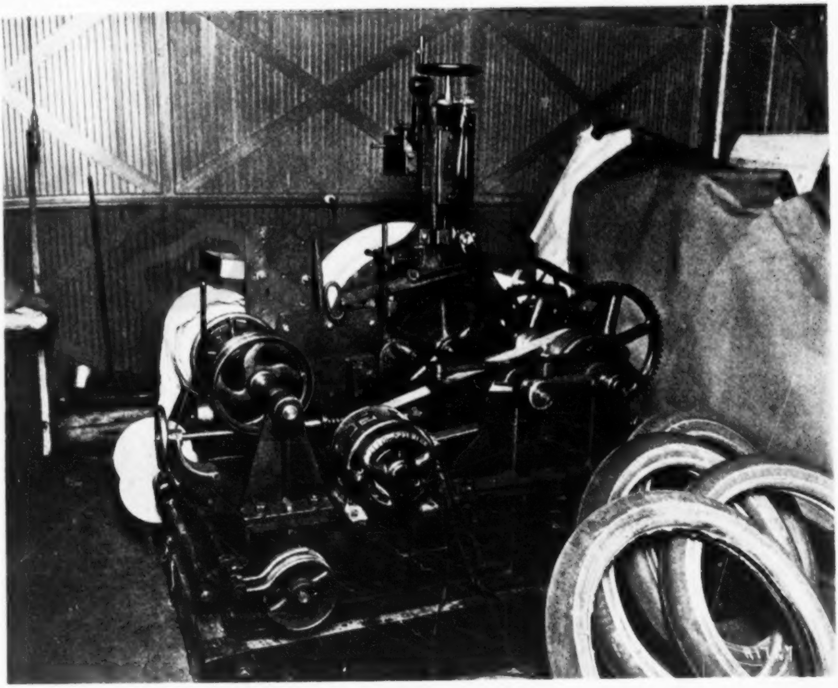
Amicus Curiae.

Canton, Ohio,
December 1, 1923.



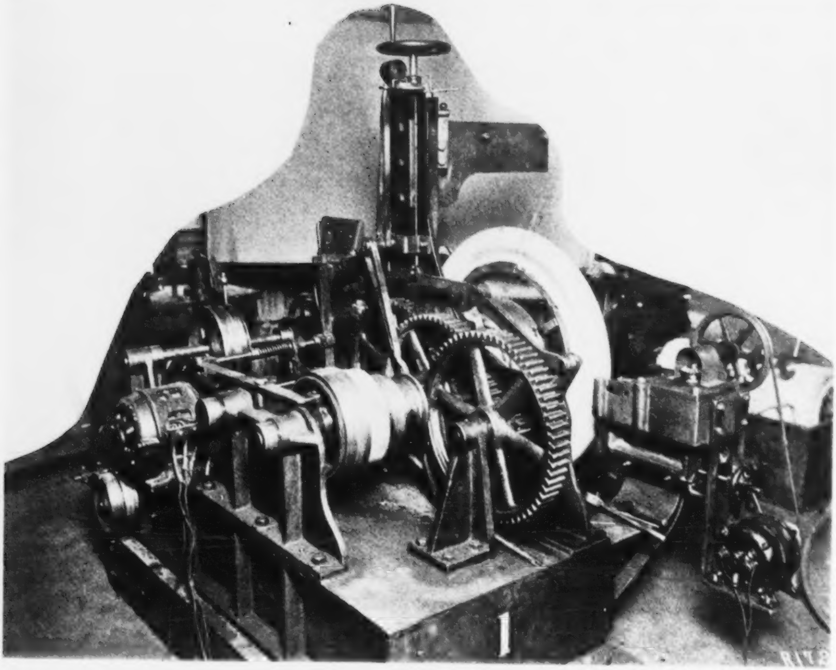
DEFENDANT'S EXHIBIT D—PHOTOGRAPHS
MATHERN MACHINE

No. 1. A perspective view of the machines, looking downward at the forward side of the machine from its right-hand corner.



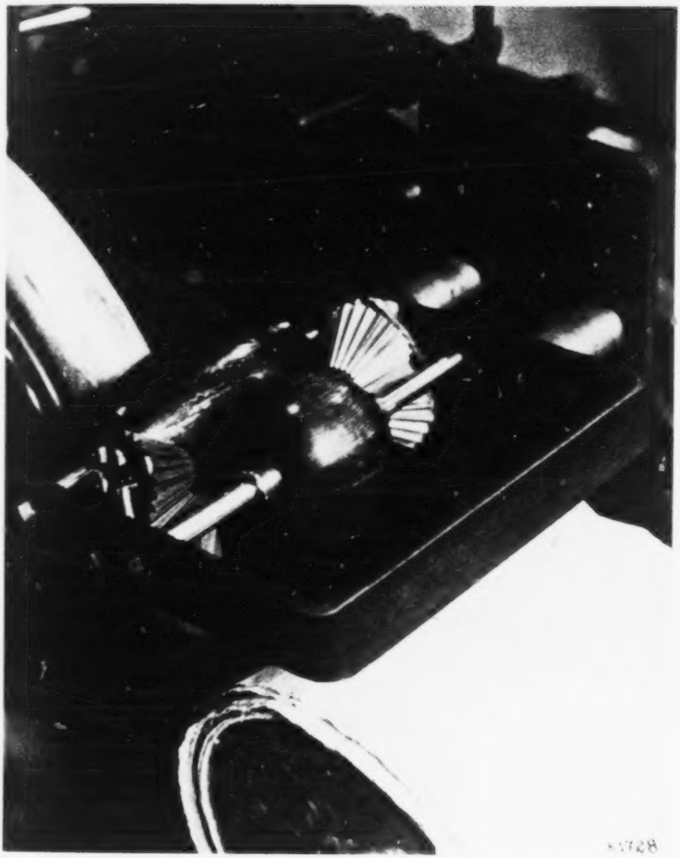
DEFENDANT'S EXHIBIT D—PHOTOGRAPHS
MATHERN MACHINE

No. 2. A perspective view of the rear side of the machine, looking at its left-hand corner, and showing some of the finished tire casings built on the machine.



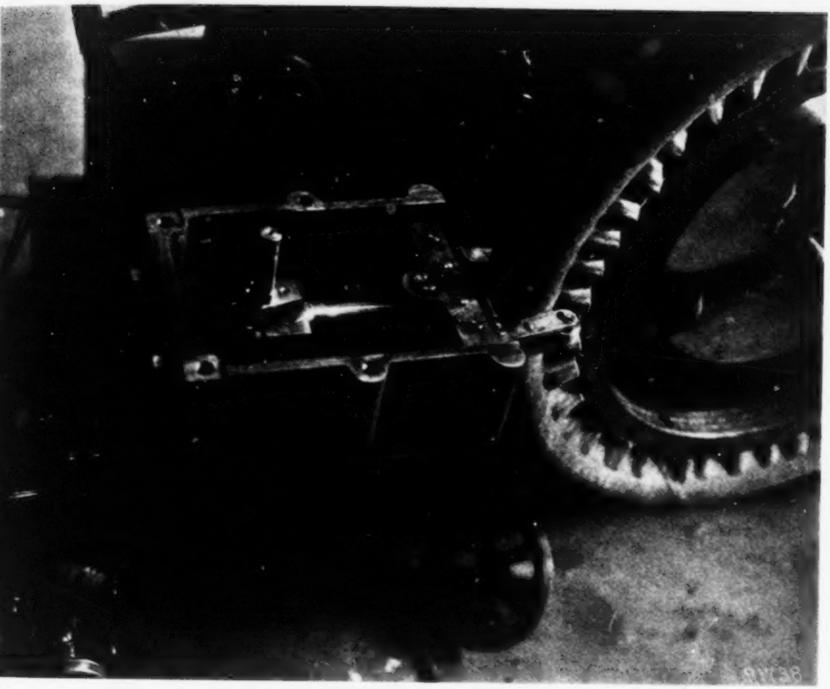
DEFENDANT'S EXHIBIT D—PHOTOGRAPHS
MATHERN MACHINE

No. 3. A perspective view of the rear side of the machine from its right-hand corner.



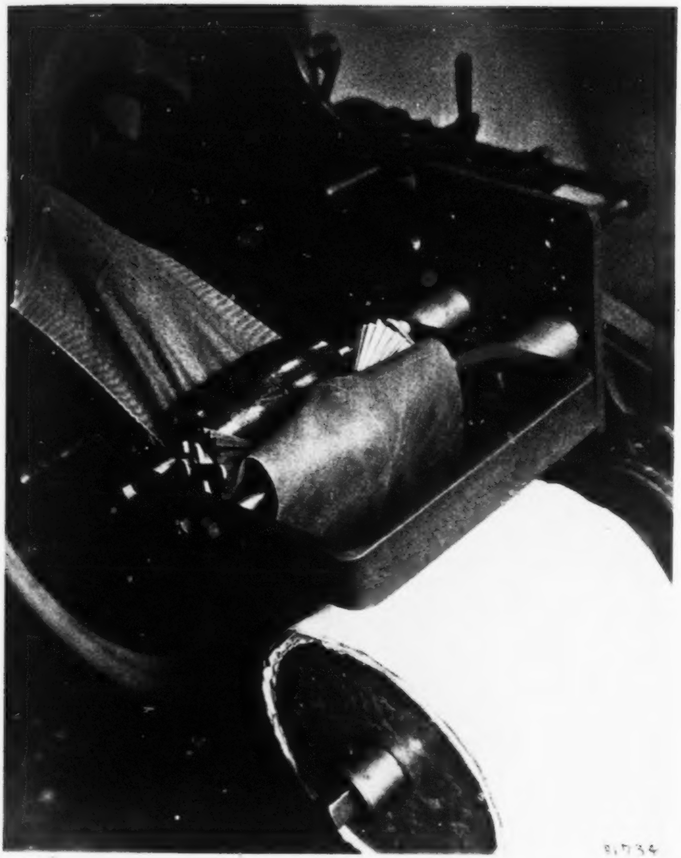
DEFENDANT'S EXHIBIT D—PHOTOGRAPHS
MATHERN MACHINE

No. 4. A perspective view of the conical gears and spherical and oval rollers.



DEFENDANT'S EXHIBIT D—PHOTOGRAPHS
MATHERN MACHINE

No. 5. A perspective view of the box or casing and reciprocating slide, carrying the rollers 30 of the Belgian patent, the cover of casing being removed to expose the parts beneath it.

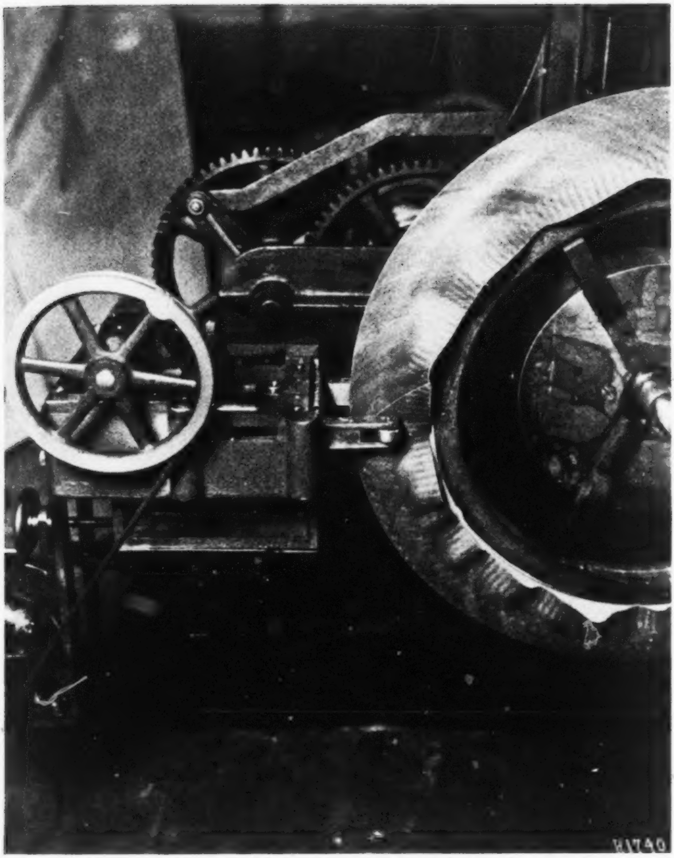


DEFENDANT'S EXHIBIT D—PHOTOGRAPHS MATHERN MACHINE

No. 6. A detail perspective view of the conical gears and the rollers, showing the initial application of the first strip of fabric to the core.

DEFENDANT'S EXHIBIT D—PHOTOGRAPHS
MATHERN MACHINE

No. 7. A similar view showing the layer of fabric completely wound around the core with its ends spliced ready for the next succeeding operation.

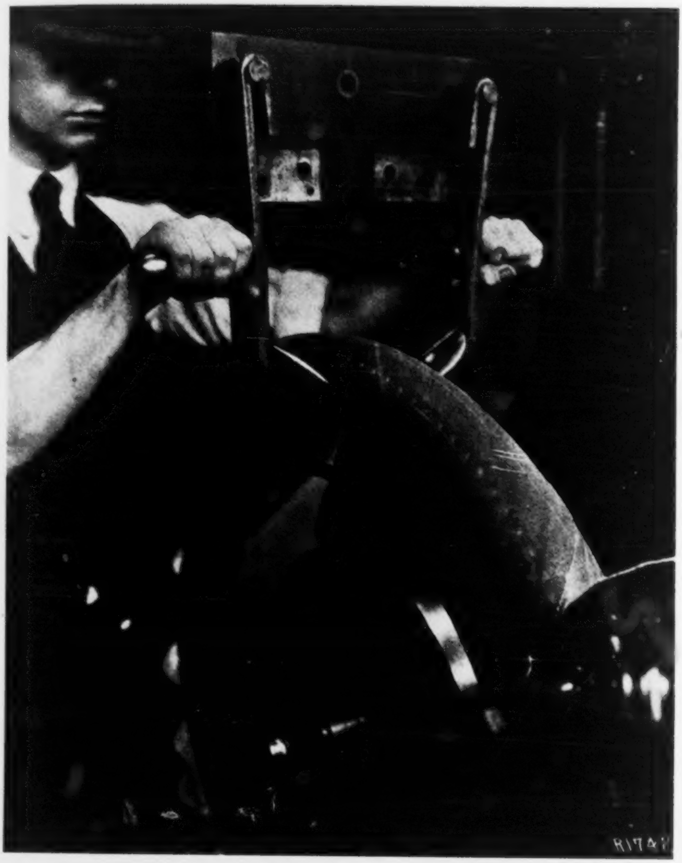


DEFENDANT'S EXHIBIT D—PHOTOGRAPHS MATHERN MACHINE

No. 8. A detail side elevation showing the action of the rollers 30 on the fabric on the core. the portion of the fabric below the rollers having been acted upon by them and the portion of the fabric above them not having reached them in the rotation of the core.

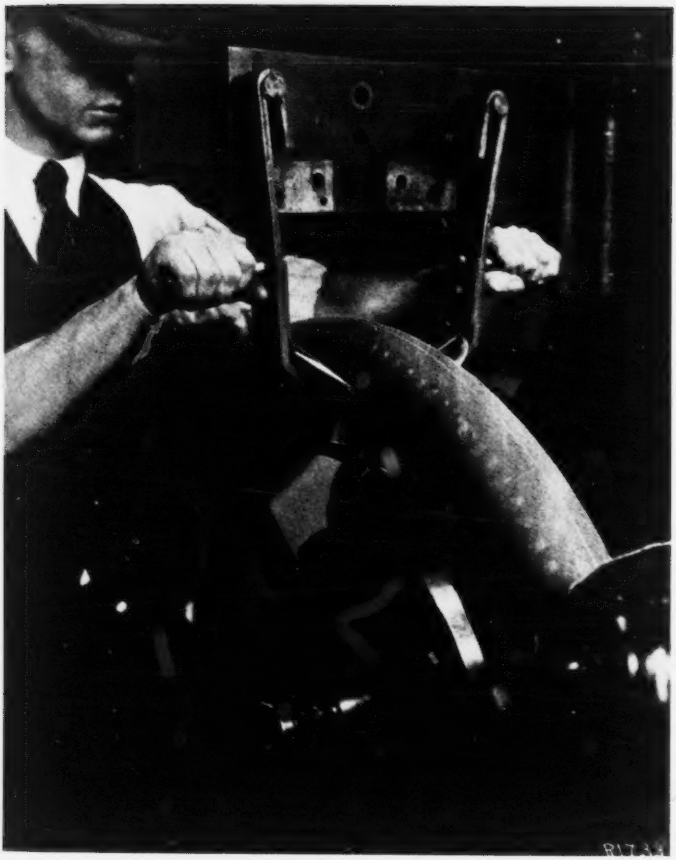
DEFENDANT'S EXHIBIT D—PHOTOGRAPHS MATHERN MACHINE

No. 9. A perspective detail showing the co-operation of the rollers 30 with the core, this view being taken from a point showing the inner part of the core. In this view the core has made a complete rotation past the rollers 30, so that they have acted upon the entire circumference of the fabric.



DEFENDANT'S EXHIBIT D—PHOTOGRAPHS
MATHERN MACHINE

No. 10. View showing the operation of the spinning rolls at or near the beginning of their action upon the sides of the fabric.



DEFENDANT'S EXHIBIT D—PHOTOGRAPHS MATHERN MACHINE

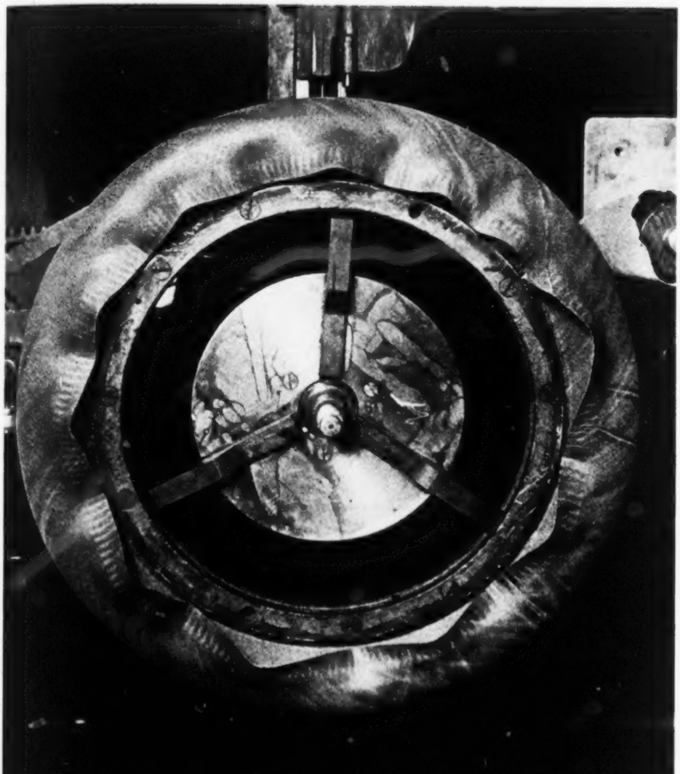
No. 11. A later stage of the same operation.

DEFENDANT'S EXHIBIT D—PHOTOGRAPHS
MATHERN MACHINE

No. 12. View showing the spinning rolls at the com-
pletion of their operation.

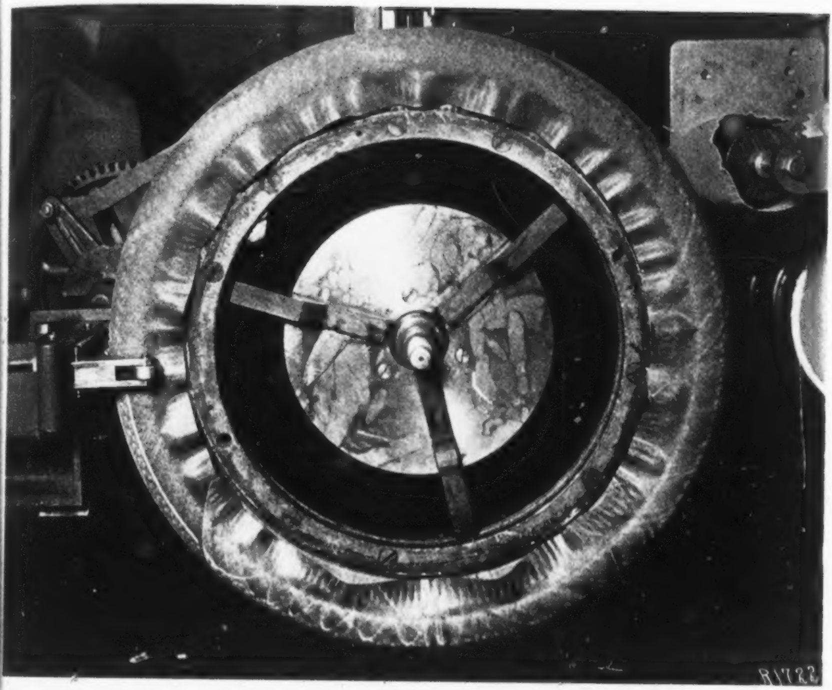
DEFENDANT'S EXHIBIT D—PHOTOGRAPHS
MATHERN MACHINE

No. 13. A side elevation of the core showing the first layer of fabric thereon after the completion of the operation of the spinning rolls.



DEFENDANT'S EXHIBIT D—PHOTOGRAPHS MATHERN MACHINE

No. 14. A similar view showing the second layer of fabric stretched around the core with its ends spliced ready for the next succeeding operation.

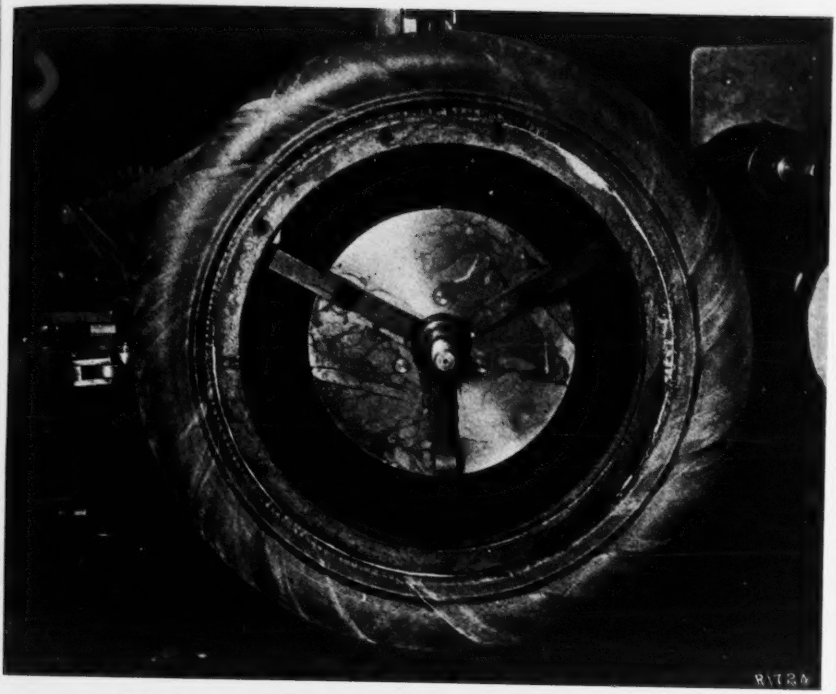


DEFENDANT'S EXHIBIT D—PHOTOGRAPHS MATHERN MACHINE

No. 15. A similar view showing the second layer of fabric after it had been acted upon by the rollers 30.

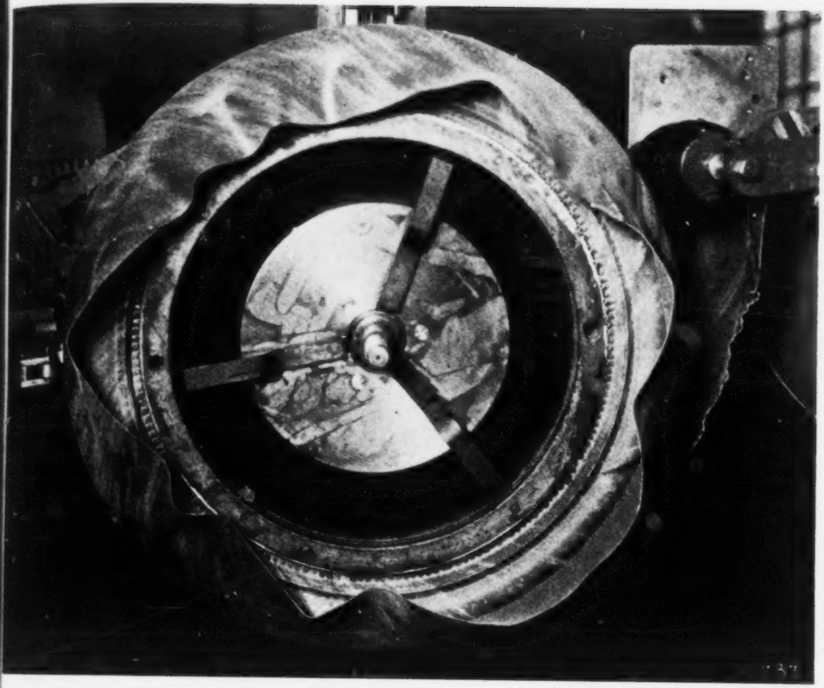
DEFENDANT'S EXHIBIT D—PHOTOGRAPHS MATHERN MACHINE

No. 16. A side elevation showing a later stage of operation, after the beads have been applied over the first two layers of fabric and the third layer has been wound upon the core and its ends spliced together for the next succeeding operation.



DEFENDANT'S EXHIBIT D—PHOTOGRAPHS
MATHERN MACHINE

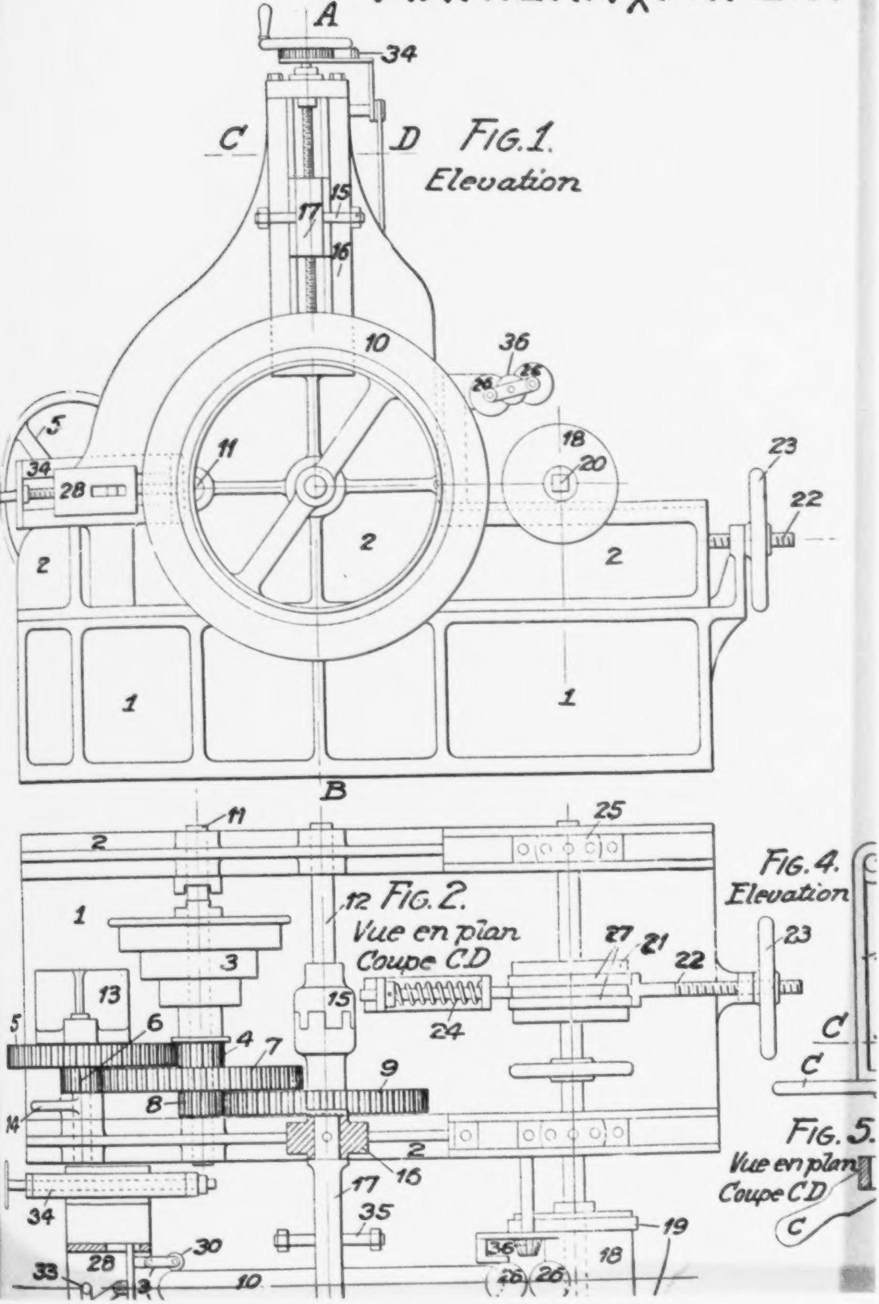
No. 17. A similar view showing the third layer of fabric after it has been acted upon by the rollers 30 and the spinning rolls and spun down over the beads.



DEFENDANT'S EXHIBIT D—PHOTOGRAPHS
MATHERN MACHINE

No. 18. A side elevation showing a strip of fabric wound upon the core without having been acted upon by the conical gears, the upper gears having been removed.

MATHERN BELGIAN PATENT



PATENT Nº 194.731

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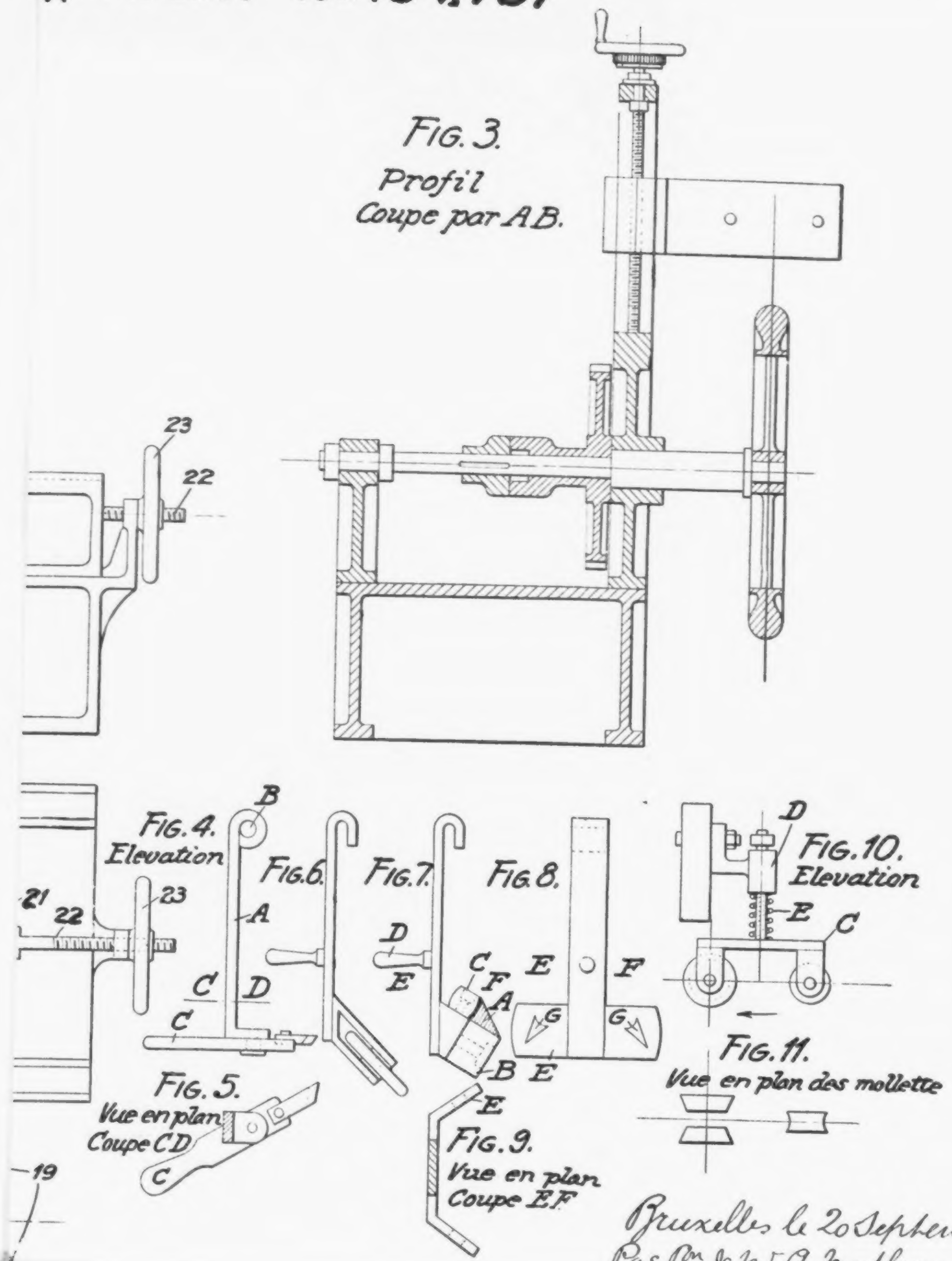

Bruxelles le 20 Septembre 1906
Pas Pon de Mr A. Matherne.

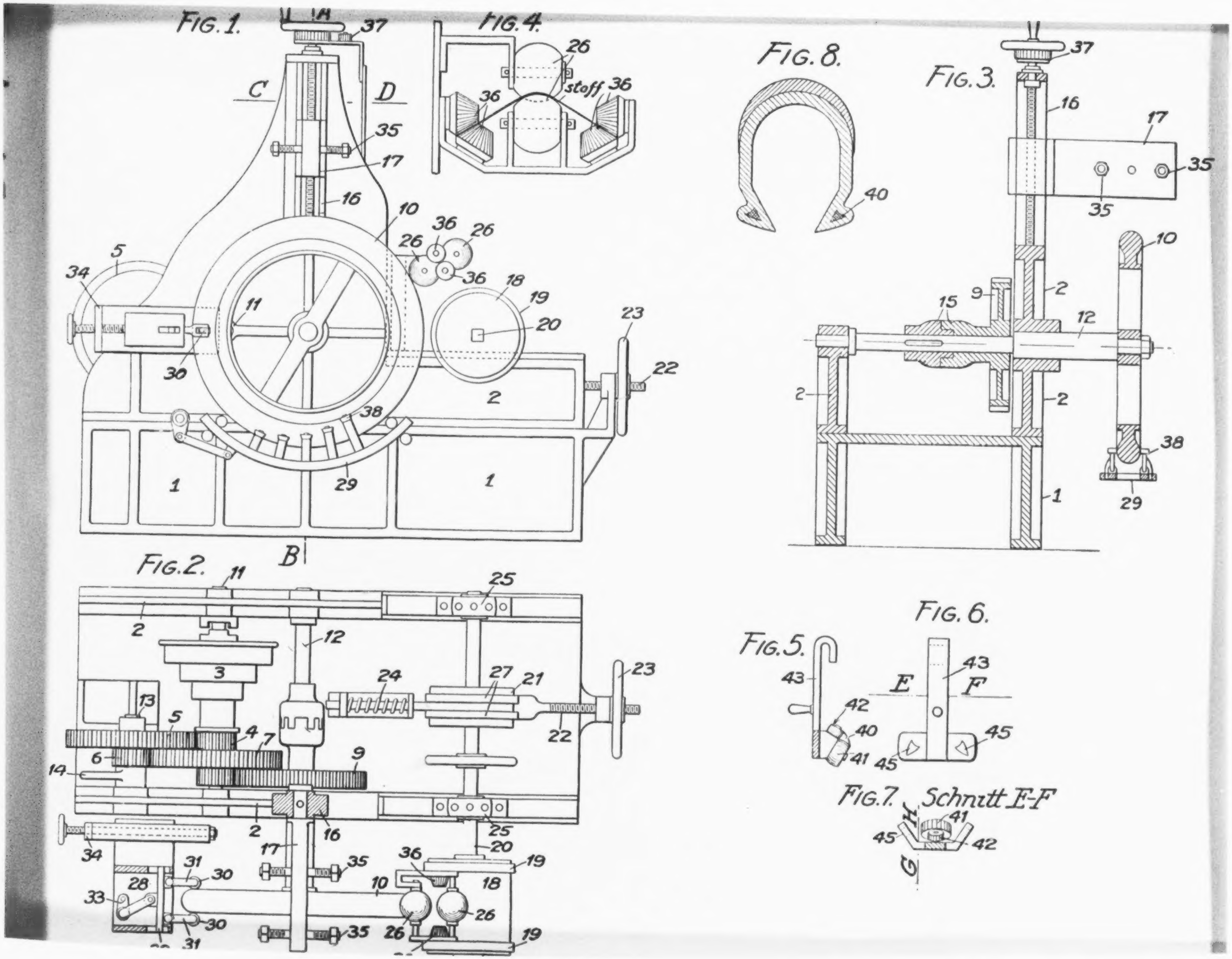

FIG. 1.
FIG. 2.
FIG. 3.
FIG. 4.
FIG. 5.
FIG. 6.
FIG. 7. Schnitt E-F
FIG. 8.
stoff
A
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Vol. II.

TRANSCRIPT OF RECORD.

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, [redacted] 1923

No. [redacted] 185

THE JOHN E. THROPP'S SONS COMPANY, PETITIONER,

vs.

FRANK A. SEIBERLING.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE THIRD CIRCUIT.

PETITION FOR CERTIORARI FILED JANUARY 2, 1923.

CERTIORARI AND RETURN FILED MARCH 20, 1923.

(29,324)

(29,324)

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1922.

No. 774.

THE JOHN E. THROPP'S SONS COMPANY, PETITIONER,

vs.

FRANK A. SEIBERLING.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE THIRD CIRCUIT.

VOLUME II.

INDEX.

JUDD & DETWEILER (INC.), PRINTERS, WASHINGTON, D. C., APRIL 4, 1923.

PLAINTIFF'S EXHIBITS.

Plaintiff's Exhibit No. 1—Patent in Suit.
(State No. 941,962.)

2

W. C. STATE.

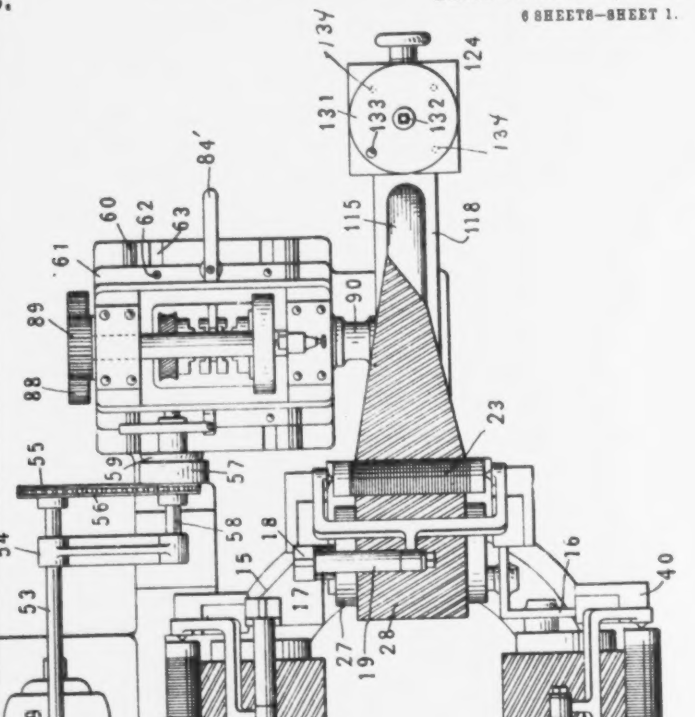
PNEUMATIC TIRE SHOE MANUFACTURING MACHINE.

APPLICATION FILED MAR. 26, 1909.

941,962. Patented Nov. 30, 1909.

6 SHEETS—SHEET 1.

Fig-1-



WITNESSES:

INVENTOR
Will C State
BY
ATTORNEY

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PNEUMATIC TIRE SHOE MANUFACTURING MACHINE.

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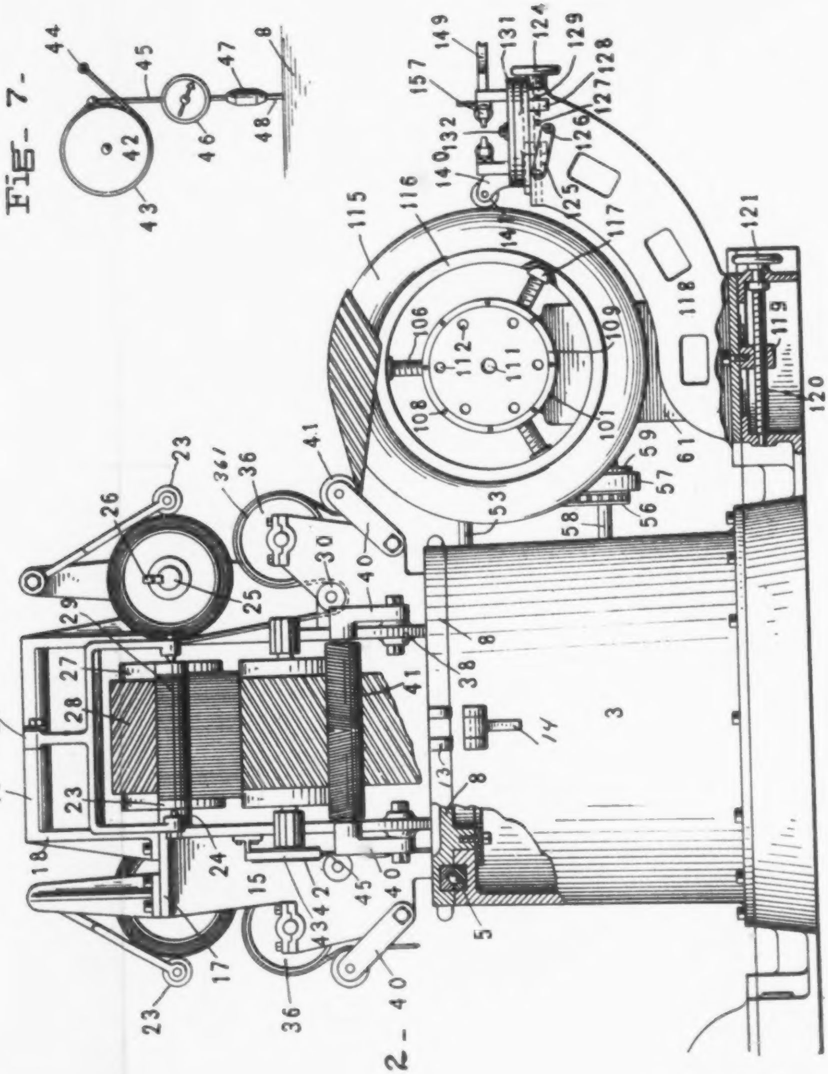

Fig. 7.

Fig. 2.

WITNESSES

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M. Setzloff

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6

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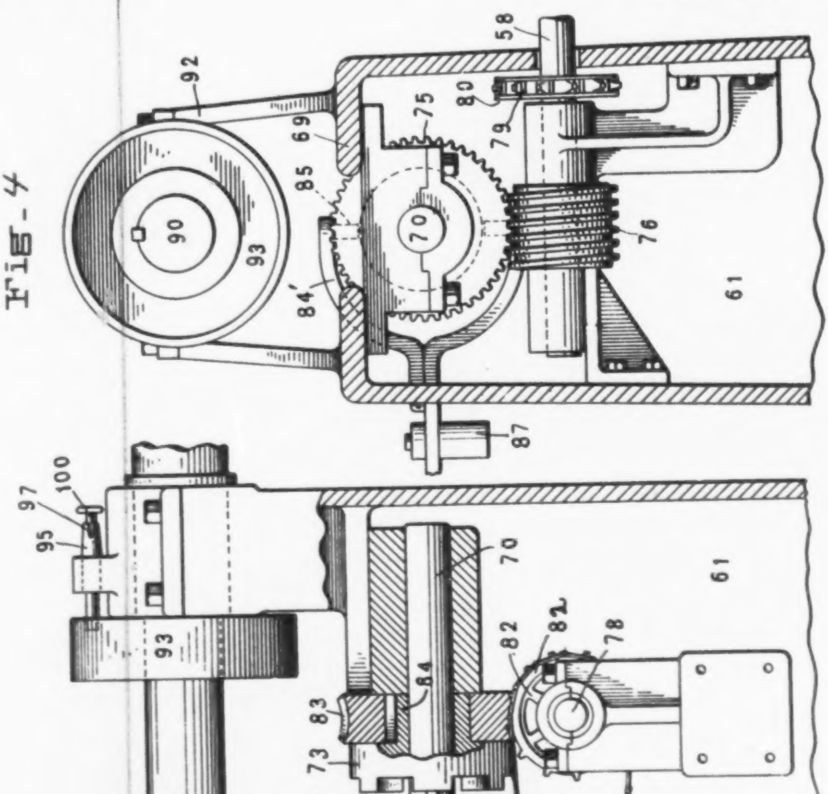
6 SHEETS—SHEET 3.



WITNESSES

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M. Tehlaff

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PNEUMATIC TIRE SHOE MANUFACTURING MACHINE.

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941,962.

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6 SHEETS—SHEET 4.

Fig-5

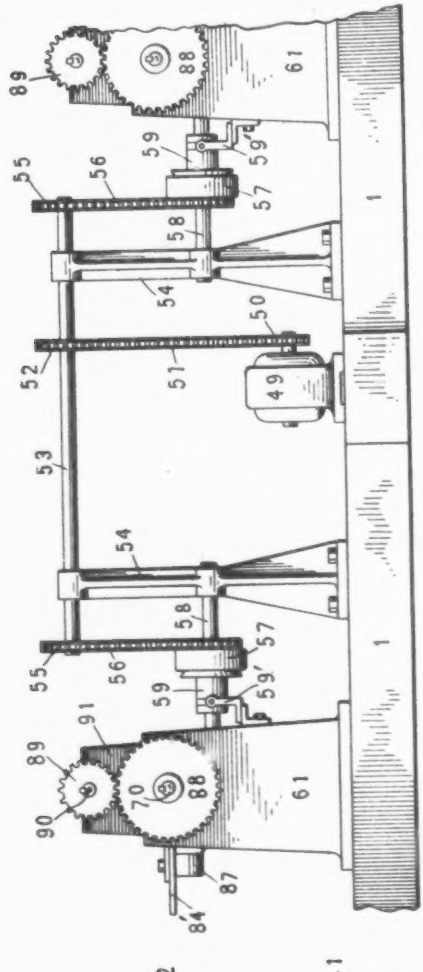
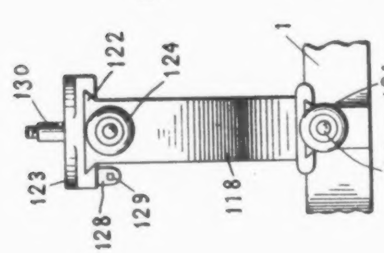


Fig-6



WITNESSES

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10

W. C. STATE.

PNEUMATIC TIRE SHOE MANUFACTURING MACHINE.

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941,962. Patented Nov. 30, 1909.

6 SHEETS—SHEET 5.

Fig. 8.

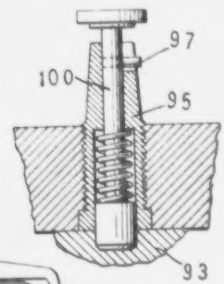


Fig. 9.

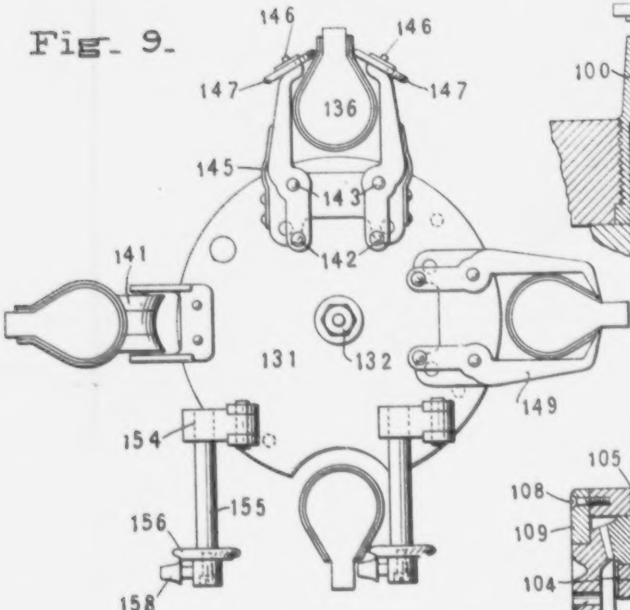


Fig. 10.

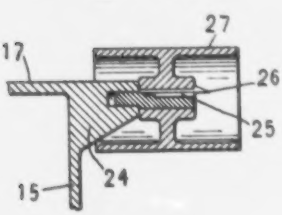
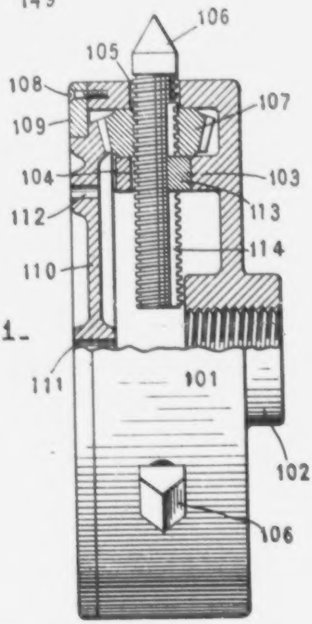


Fig. 11.



WITNESSES:

J. Clyde Kipley.

M. Tetzlaff

INVENTOR

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BY Gustav Bornemann

ATTORNEY

W. C. STATE.

PNEUMATIC TIRE SHOE MANUFACTURING MACHINE.

APPLICATION FILED MAR. 26, 1909.

941,962. Patented Nov. 30, 1909.

6 SHEETS—SHEET 6.

Fig. 12.

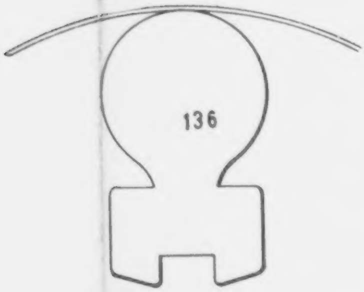


Fig. 12a.

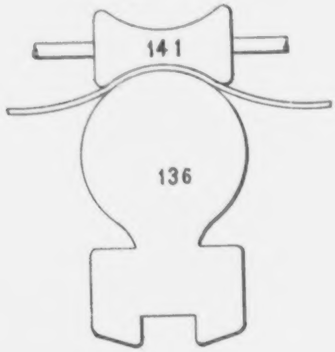


Fig. 12b.

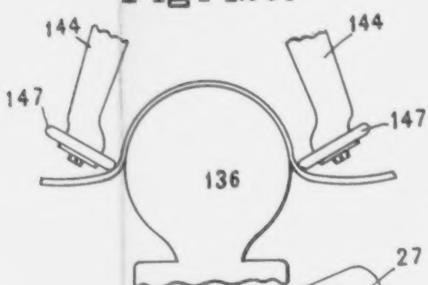


Fig. 12c.

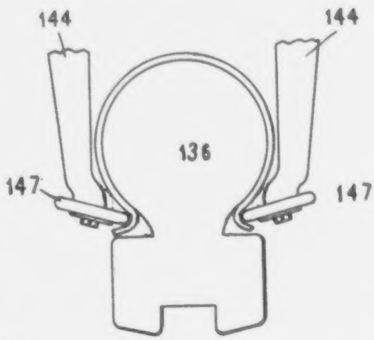


Fig. 13.

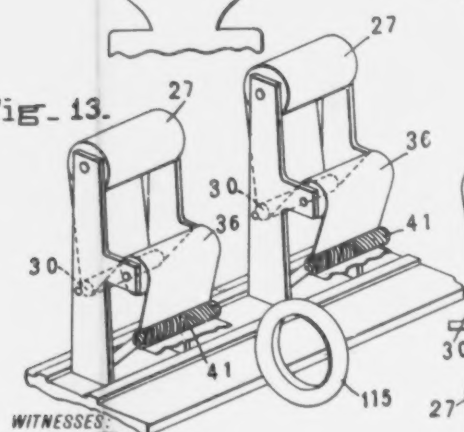
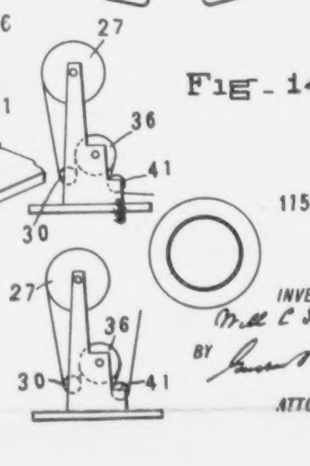


Fig. 14.



WITNESSES:

J. Clyde Ripley.

M. Tetzlaff

INVENTOR

Will C State

BY

ATTORNEY

Disclaimer in Letters Patent No. 941,962.

941,962.—*Will C. State*, Akron, Ohio. PNEUMATIC-TIRE-SHOE-MANUFACTURING MACHINE. Patent dated November 30, 1909. Disclaimer filed February 14, 1919, by the assignee, *Frank A. Seiberling*.

Enters his disclaimer as follows:

"First. In respect to each of claims 4, 5, 6, and 7 of said patent, I hereby disclaim any combination of the recited elements *except when* constructed and coördinated for shaping and applying a previously unshaped sheet-fabric strip to that part of the recited ring-core beyond the tread portion, *and unless* the ring-core is rotatable at fast speed by the power-drive, whereby the unapplied fabric portion is thrown out from the side of the ring-core by centrifugal force, and the recited spinning-roll support is mechanically mounted to insure its radial movement with a gradual advance in proper relation to the fast rotating ring-core, whereby the spinning-roll, by such gradual advance over the ring-core and while pressed toward it, acts gradually upon the centrifugally thrown-out fabric to shape it to the side of the rotating ring-core while bringing it into adhesive contact therewith.

"Second. In respect to each of claims 12 and 13 of said patent, I hereby disclaim any combination of the recited elements, *except for* the combined operations of first stretching the middle or tread portion of a previously unshaped fabric strip onto the recited ring-core and thereafter shaping and applying to the ring-core the fabric beyond the tread portion, *and unless* the recited elements are so constructed and coördinated that before the change from slow speed to fast speed the fabric strip as drawn from the recited stock roll onto the ring-core is stretched circumferentially under uniform tension while applying it to the tread portion, and, after the change to fast speed, the unapplied fabric beyond the tread portion is thrown out from the side of the ring-core by the consequent centrifugal force, while the recited spinning-roll, in its radial movement, acts gradually upon the centrifugally thrown-out fabric, to shape it to the side of the rotating ring-core beyond the tread portion while bringing it into adhesive contact therewith.

"Third. In respect to each of claims 22, 23, 24, 25, and 26, of said patent, I hereby disclaim any combination of the recited elements *except when* constructed and coördinated for shaping and applying a previously unshaped sheet fabric strip to that part of the recited ring-core beyond the tread portion, *and unless* the power-drive for the ring-core functions by a sufficiently high speed of rotation and consequent centrifugal force to throw the unapplied fabric portion out from the side of the ring-core, while the recited spinning-roll, in its radial movement and while pressed toward the ring-core, functions by a gradual action upon such centrifugally thrown-out fabric, to shape it to the side of the rotating ring-core while bringing it into adhesive contact therewith.

"Fourth. I hereby further disclaim that part of the claim of invention in said patent contained in claims 8, 9, 10, 11, 14, 15, 16, and 17, respectively.

"Fifth. In respect to the specification of said patent, I hereby disclaim at page 1, lines 79–80, the words 'and an important feature of my invention,' and at page 1, lines 92–93, the words 'as another feature of my invention.'"

ing machine of a power-driven ring-core with a pair of stock-rolls from which alternate layers of crossed fabric may be supplied to the ring-core is an important feature of my invention.

A layer of canvas having been applied to the ring-core, a radially movable smoothing or tread-forming roll firmly shapes and presses the canvas against the ring-core near its external periphery to form the parts to which some form of tension brake is applied. I have found, also, that the fabric in passing under tension from the stock-roll to the ring-core forms longitudinal creases. These I remove by a stretching-roll supplied with a pair of divergent spirals on its surface.

Without unduly extending this preliminary outline of my invention, I may say that an important feature of my machine

WITNESSES:

INVENTOR

BY

ATTORNEY

UNITED STATES PATENT OFFICE.

WILL C. STATE, OF AKRON, OHIO, ASSIGNOR TO FRANK A. SEIBERLING, OF AKRON, OHIO.

PNEUMATIC-TIRE-SHOE-MANUFACTURING MACHINE.

941,962. Specification of Letters Patent. Patented Nov. 30, 1909.

Application filed March 26, 1909. Serial No. 486,043.

To all whom it may concern:

Be it known that I, WILL C. STATE, a citizen of the United States, and resident of Akron, Summit county, Ohio, have invented a new and useful Pneumatic-Tire-Shoe-Manufacturing Machine, of which the following is a specification.

My invention relates specifically to the manufacture from flat sheets of rubber-coated canvas of the open-bellied casings or more briefly the open casings or tire-shoes which are used in connection with an inflatable inner rubber tube to constitute the double-tube pneumatic tires now used on automobiles and the like. Heretofore such open-bellied or open tire-shoes in so far as they have been made direct from sheeted fabric have been made by hand. By my invention they are made by the machine which is the subject of this application. It is the first machine, known to me, which has come into commercial use for this purpose of building tire-shoes from superposed layers of sheeted fabric in contradistinction to weaving the tires from threads which are woven or laid one after the other on the ring-core or former.

My machine comprises a power-driven ring-core in connection with a pair of stock-rollers which have wound thereon strips of canvas skim-coated with rubber and cut on the bias. By this means I am enabled to supply a round of canvas on the ring-core from one roll and then a second round of canvas on the ring-core from the other roll. By properly arranging the rolls with respect to each other, the superposed layers of canvas on the ring-core will have their threads crossed, as is necessary in building strong tires. The pair of stock-rollers may be mounted one above the other, or side by side on a sliding or rotary table so that the stock can readily be drawn therefrom to the power-driven ring-core in alternation. This combination in an open tire-shoe making machine of a power-driven ring-core with a pair of stock-rolls from which alternate layers of crossed fabric may be supplied to the ring-core is an important feature of my invention.

A layer of canvas having been applied to the ring-core, a radially movable smoothing or tread-forming roll firmly shapes and presses the canvas against the ring-core near its external periphery to form the parts of the tire which lie under its tread portion. Thereupon a pair of spinning-rolls by radial motion with respect to the ring core gradually press the canvas in contact with the sides of the ring-core toward its internal periphery to shape the sides of the tire. These spinning-rolls are preferably spring-pressed and their outer periphery or working edge is disk-shaped and rounded so as not to cut the fabric. The spinning-rolls are also radially movable with reference to the ring-core. They have been found peculiarly efficient in shaping the sides of the tire-shoe and form an important feature of my invention. They are sharply differentiated from the hammers or sliding finger devices heretofore proposed for the purpose. So, too, the combination of the tread-forming roll for operating upon the tread portion and the spring-pressed spinning-rolls for shaping the sides of the tire-shoe by radial motion with reference to the ring core forms an effective instrumentality for completely shaping the tire and an important feature of my invention.

In order to prevent the several spiral layers of canvas, which are skim-coated or saturated with rubber, from sticking together while on the stock-roller, I place a strip of plain muslin or the like against the rubber-coated canvas and wind this combination upon the stock-roll. It becomes important, then, when the rubber coated canvas is drawn onto the ring-core from the stock-roll that provision be made for disposing of the muslin which is unwrapped at the same time. To this end I apply as another feature of my invention a take-up roll for the muslin which is driven by frictional contact against the outer surface of the stock-roll.

It is important to secure proper tension on the fabric as this is drawn from the stock-roll onto the ring-core. To this end I cause the fabric to pass over a rubber-covered roll to which some form of tension brake is applied. I have found, also, that the fabric in passing under tension from the stock-roll to the ring-core forms longitudinal creases. These I remove by a stretching-roll supplied with a pair of divergent spirals on its surface.

Without unduly extending this preliminary outline of my invention, I may say that an important feature of my machine

results from the fact that I apply the canvas to the power-driven ring-core while this is moving quite slowly, say at six revolutions a minute. I have discovered, however, that it is not only possible but highly desirable to let the smoothing- and spinning-rolls operate upon the ring-core while this is moving at a much higher speed, say at two hundred and seven turns a minute. By this means the machine not only does more work in a given time but it does better work.

I shall now describe, in detail, the machine which constitutes the best embodiment of my invention now known to me.

In the drawings,—Figure 1 is a plan of my device; Fig. 2 is a view in side elevation looking from the right of Fig. 1 with portions in section to illustrate the internal construction thereof; Fig. 3 is a sectional view of the mechanism for supporting and rotating the core; Fig. 4 is a sectional view of the mechanism shown in Fig. 3; Fig. 5 is a view in side elevation of the mechanism for communicating motion to the mechanism shown in Figs. 3 and 4; Fig. 6 is a view in end elevation of the support and tool carriage on which the devices used for manipulating, shaping and smoothing the fabric while being placed on the core are mounted; Fig. 7 is a view in side elevation of a tension regulating device; Fig. 8 is a view, in central section, of a lock employed in this device; Fig. 9 is a plan of a turret on which the mechanisms for manipulating the tire are mounted, also showing the various tools employed in connection with this type of device on a ring-core shaped for clencher tires; Fig. 10 is a sectional view of a standard and reel on which a supply of rubber-coated fabric is mounted; Fig. 11 is a view partly in elevation and partly in section of a chuck on which the core is mounted while the tire is being formed thereon; Figs. 12, 12ª, 12ᵇ, 12ᶜ are cross-sections of a ring-core for inextensible-edge tires with the fabric in different stages of application; Fig. 13 is a diagram of a ring-core used alternately in connection with a pair of stock-rolls on a sliding support; and Fig. 14 is a diagram of a pair of superposed stock-rolls used alternately in connection with a ring-core.

Referring to the drawings in detail, 1 is the base carrying a cylindrically-formed member 3 upon which loosely turns the rotary head 8 by means of a ball-bearing connection 5. The base 8 is provided with a series of pairs of lugs 13, the space between each pair forming a recess to receive a locking member 14 mounted on the side of the cylinder 3 for arresting at predetermined intervals the movement of the head. Extending upwardly from the head 8, as seen in Fig. 1, are two varieties of standards 15, 16. The four standards are L-shaped in cross-section and are positioned with the angles or corners thereof inwardly toward the axis of the cylinder 3. Mounted on these standards 15 and 16 are four complete sets of rolls, and as these sets of rolls are similar, a description of one will be sufficient. Each set of rolls comprises a stock-roll, which constitutes my sheet fabric supply a take-up roll, an idle roll, a rubber-covered tension-roll and a stretching-roll which will now be described. Extending laterally from the standard 15 is an integral arm 24, shown best in Fig. 10, from the outer end of which projects a stub shaft 25 provided with a spring catch 26 for holding a stock-roller 27 on which the supply of rubber-saturated fabric 28 is wound, the successive layers of which are prevented from sticking together by interposing between them a strip of muslin or cloth 29. By releasing the catch 26, the roller 27 may be removed from its shaft 25 and replaced by another roller on which a fresh supply of fabric and cloth is wound whenever the supply on the original roller becomes exhausted.

Mounted on the shelf 17 (Figs. 1 and 2), which extends horizontally across the upper corner or angle of the standards 15, is an upright hanger 18 having a laterally extending arm 19 to the free end of which is pivotally mounted a depending yoke 20 and having mounted on pins in its free ends thereof a roller 23, hereinafter designated as the take-up roller. Below the arm 24 is an idle roller 30 (see Fig. 2) mounted between the standards 15 and 16.

In the front or outer portion of the standards 15, 16 are bearings to receive a shaft on which is mounted a tension roller 36, preferably having its outer face covered with a layer of vulcanized rubber 361, which rubber-coating I have found peculiarly efficient. The tension-roll constitutes a highly important element since it secures the application of the several layers of fabric to the ring-core with a uniform degree of tension. To this end there is mounted on one end of the shaft which bears the tension-roller 36 (Figs. 2 and 7) a disk 42 around which is a friction band 43 having one end anchored to a post 44 on one of the standards and having its other end connected to a rod 45 bearing a tension measuring gage 46 and a turnbuckle 47 at its lower end. The turnbuckle 47 is connected with some fixed support such as the base 8 by means of a second rod 48. If increased tension is desired on the tension-roller 36 the turnbuckle 47 is manipulated so as to cause a contraction of the friction band 43 on the disk 42 to a determined degree, indicated by the gage 46 so that a predetermined amount of resistance will be offered to the turning or movement of the tension-roller 36.

I have found that as the ring-core draws the fabric under tension from the stock-

rolls, the fabric forms troublesome longitudinal creases which must be gotten rid of. The expedient which I have finally hit upon for this purpose consists of a stretching-roll 41, here shown as mounted in a swinging frame 40. The outer surface of the stretching-roller 41 is provided with two spirally arranged sets of grooves both commencing at the longitudinal central line thereof and diverging spirally therefrom to cause it to laterally stretch and smooth the rubber-saturated fabric which is drawn partly around it in its passage from the tension-roller, the effect of the roller being to remove all longitudinal creases and other wrinkles which will be formed in the fabric during the removal of the stock from the stock-roller on its passage to the ring-core. The arms 40 are permitted to swing on bolts and are held in any determined position by tightening nuts. By passing the fabric over the tension-roll and under the stretching-roll, the fabric is in contact with the surfaces of these rolls for a considerable fraction of the circumference.

It will be understood that the stock-roll the idle roll, the tension-roll and the stretching-roll constitute a single set of rolls, there being, in the case shown, four sets or two pairs of sets of rolls in all, one pair of set of rolls coöperating with one ring-core and the other pair of set of rolls coöperating with the other ring-core. Considering the pair of stock-rolls which coöperate with a single ring-core, it is understood that the rubber-coated canvas is applied to the two stock-rolls at alternate angles which means that when the stock rolls coöperate with the ring-core the threads of the fabric from one roll will be at an angle with the direction of the threads of the fabric from the other roll. This is brought about, in the construction which has just been described, by mounting a pair of set of stock-rolls upon the rotary head 8. But the same result could be obtained among numerous other ways by mounting a pair of stock-rolls upon a sliding head, as shown in Fig. 13, or by mounting the stock-rolls one above the other, as shown in Fig. 14 and placing the stock upon the pairs of stock-rolls so that their threads will come at angles to each other when supplied to the ring-core.

The operation of a set of rolls is as follows: In order that the ring-core may take hold of the fabric, the core is coated with rubber or cement. The rubber-coated canvas is now unwound from the stock-roll and carried downwardly under the idle roll 30, and from thence upwardly around the tension-roll 36, and from thence downwardly under and around the stretching-roll 41, and finally onto the power-driven ring-core to which the end of the canvas is made to adhere. Since the ring-core is power-driven at a low speed, the rubber-coated canvas will be drawn outwardly from under the surface of the stretching-roll as well as over the surface of the tension-roll. In this manner the fabric will be smoothed by the stretching-roll and the proper tension will be applied to it by the tension-roll. When one round of canvas has been applied to the ring-core, the length is cut off by the workman's scissors from the portion remaining on the stock-roll. The cloth which is interposed between the layers of the rubber-coated canvas on the stock-roll passes downwardly around the under face of the stock-roll and frome thence upwardly and is then rewound on the take-up roll 23 which, being hung between the arms of the pivoted yoke 20, frictionally rests on the surface of the stock-roll 27, thus receiving motion thereby. During the operation of withdrawing the strip of rubber-coated canvas from the stock-roll, the lug 14 (Fig. 2) will be inserted in the recess between the lugs 13 to prevent the revolution of the head 8.

I have now to describe the source of power for the ring-core. Mounted on the base 1 is a motor 49 having a sprocket wheel 50 driving a sprocket chain 51, passing around a sprocket wheel 52, on a shaft 53, supported by brackets 54. The shaft 53 bears, at its ends, sprocket wheels 55 driving sprocket chains 56, passing around the loose members of clutches 57, which with their coöperating tight members 59 are mounted on shafts 58 (Figs. 3, 4, 5) and are operated by clutch levers 59. Mounted on suitable ways 60 at each end of the base 1 are housings 61. Each of these housings may be provided on its under surface with suitable grooves so as to render them movable on the ways 60 and is held in a determined position by means of bolts 62, the lower ends of which engage in slots 63 formed in the base 1. The housing 61 is hollow and is provided with an opening through which the shaft 58 enters (Fig. 4). Within the housing are a pair of alined brackets provided with bearings bolted to the walls of the housing and supporting one end of the shaft 58. Extending longitudinally of the housing 61 and supported in bearings suitably secured to inturned flanges 69 formed integral with the body of the housing is a shaft 70 near the longitudinal center of which is splined a clutch member 71 having its two lateral faces formed to engage corresponding clutch members 72 and 73 mounted loosely on said shaft 70. The clutch member 72 is provided with a hub 74 rigidly secured to a spiral gear 75 adapted to be driven by means of a worm 76 mounted on the shaft 58 just as the corresponding clutch member 73 has a hub 84 secured to a spiral pinion 83 driven by a worm 82 on a shaft 78. The shaft 78 is driven from the shaft 58 by a

chain and sprocket connection and the arrangement is such that the spiral gear 83 rotates much more rapidly than the spiral gear 75. It will thus be seen that the shafts 58 and 78 are constantly power driven and rotating. With them rotate the clutch-members 72 and 73, which are loose on the shaft 70. By throwing the clutch member 71, which is splined on the shaft 70, into connection with either the clutch member 73 or 72, the shaft 70 is made to revolve slowly or rapidly. The movement of the clutch member 71 is effected by the shifting lever 86.

Mounted on the shaft 70 outside of the housing 61 is a gear 88 (Fig. 5) adapted to mesh with a pinion 89 secured to the extended end of a shaft 90, mounted in the upper part of the housing 61 and carrying a locking-disk 93. Coöperating therewith is a spring pressed locking pin 100 held out of engagement with the locking-disk by a cross pin 97 moving in a slot in the casing 95 (Fig. 3). To lock the shaft 90 in a fixed position, the pin 100 is allowed to assume the position shown in Fig. 3. To permit the shaft 90 to rotate, the pin 100 is withdrawn from contact with the locking-disk 93 and held in this withdrawn position by the cross pin 97 which bears against the end of the casing 95, all in a manner readily understood.

I have now to describe the chuck for carrying the ring-core. Mounted on the shaft 90 is a chuck (see Fig. 11) comprising a cup-shaped body portion 101 provided with an internally threaded hub 102 to receive the end of the shaft 90. The interior of the member 101 is further provided with a flange 103 provided with openings 104 in radial alinement with similar openings 105 in the outer face of the chuck. Positioned in these openings 104 and 105 are exteriorly threaded shafts 106 bearing between the flange 103 and the outer wall of the chuck, nuts 107 the exterior faces of which are formed with beveled gear teeth. Secured to the outer wall of the chuck by means of screws 108 is an annular flange or ring 109 extending inwardly from the outer wall of the cup-shaped member a short distance. Mounted in the space inclosed by the ring 109 is a disk 110 provided with a central opening 111 and with a plurality of openings 112 disposed in a circle concentric with the opening 111. The outer edge of the disk 110 is provided with a shoulder to receive the ring 109 for positioning and holding the disk in place. The inner face of the disk is provided with gear teeth adapted to intermesh with the teeth on the nuts 107. Mounted in the flange 103 are keys 113 arranged to enter key-ways 114 [illegible] longitudinally of the shafts 106 for locking them against rotation in unison with the nuts 107. The outer ends of the shafts 106 are preferably beveled to form a sharp edge for a purpose to be hereinafter described. This chuck is adapted to temporarily hold the ring-core on which the tire casing is to be built. The ring-core (Fig. 2) is provided with an inwardly-extending flange 116 having at intervals V-shaped slots 117 to receive the outer ends of shafts 106.

While I have described the mechanism for driving and supporting the ring-core in detail, so that its exact construction may be understood, it will be seen that in its essence I employ a slow-speed mechanism, in this case represented by the clutch member 73, and a fast-speed mechanism, here represented by the clutch member 72, and a speed-changing mechanism, here represented by the clutch member 71 and its shifting lever 86. But when I use the terms fast-speed mechanism, slow-speed mechanism and speed-changing mechanism in the claims, it is understood I mean any class of mechanism accomplishing these functions and not merely the specific mechanism herein shown. Power is thus transmitted from the shafts 50, 53, 58 (Fig. 5) to the shaft 70 (Fig. 4), and in turn to the shaft 90 which, by means of a suitable chuck, carries the ring-core. To mount the ring-core on the chuck, the shifting lever 86 is placed in its intermediate position with the clutch member 71 out of contact with either the fast- or slow-speed mechanism. The locking-stem 100 is now permitted to come into engagement with the locking-disk 93 to hold the shaft 90, which carries the chuck, in an immovable position. This permits the ring-core to be readily placed on the chuck. Thereupon the locking-stem 100 is withdrawn from engagement with the locking-disk 93 and the speed-shifting lever 86 is operated to throw the slow-speed mechanism into action. The ring-core is now rotated at a slow speed. At this time a single layer of rubber-coated fabric is drawn onto the ring-core from the stock-roll. The shifting-lever is now quickly actuated to stop rotation of the core. Thereupon a pair of scissors in the hand of the operator separates the strip of rubber-coated canvas, which is around the core, from the canvas wound on the stock-roll. The speed-changing mechanism is now again actuated to bring the fast-speed mechanism into action. Thereupon the tread-forming and spinning-rolls are brought into play. The supports for these I now proceed to describe.

Slidably mounted on the base 1, substantially below the position occupied by the chuck just described, is a housing 118 comprising a hollow metallic box having outlines approximately concentric with the shaft 90 provided with a depending lug 119 in its lower portion through which extends a screw 120, manipulated by a hand-wheel 121 for shifting the housing 118 toward and away from the ring-core 115, thereby mak-

ing it possible to position and adjust it with respect to the latter when different sized cores are used. The upper portion of the housing 118 is provided with an outwardly-extending dovetailed portion 122 on which is slidably mounted a carriage 123 provided with a depending lug, indicated in dotted lines in Fig. 2, similar to the lug 119, adapted to receive a screw controlled by a hand-wheel 124 for shifting it toward and away from the core.

In the side of the housing 118 immediately below the carriage 123 is a pivoted arm 125 provided with a pin 126 adapted to enter a hole 127 in the side of the housing 118. Depending from the side of the carriage 123 is a lug 128 provided with a pin 129 threaded to permit its adjustment in the lug 128. When the arm 125 is swung upwardly so that the pin 126 is positioned in the hole 127 the pin 129 will engage the arm 125 and arrest further inward motion of the carriage thereby constituting an adjustable stop for accurately limiting the movement of the carriage with respect to the core. The carriage 123 bears an upwardly-extending centrally-placed pin 130 on which is mounted a revoluble head or turret 131 held from displacement by a nut 132. Reference is here directed to Fig. 9. The turret 131 bears a lock 133 exactly similar to the lock shown in Fig. 8, provided with a vertically-shiftable stem the lower end of which is adapted to enter suitable openings 134 in the upper face of the carriage 123 and lock the turret in determinate positions.

The revolving head or turret 131, which is shown simply as a sample of one type of transversely movable support I may employ, bears what for lack of a more suitable name I call the tread-forming-roll 141, the spinning-rolls 147, the cutters 149 and the bead-attaching roll 156, which can be alternately brought into play because of the rotary or transverse movement of the head 131 with respect to the ring-core. These instrumentalities may be juxtaposed to the ring-core, one after the other, by rotating the head. Since the supporting head 131 is radially movable with reference to the ring-core by means of the hand-wheel 124, it follows that each of the instrumentalities mounted thereon is radially movable with respect to the ring-core. In the case of the tread-forming-roll 141, this permits the operator to gradually bring the proper amount of pressure to bear on the canvas either which lies under or which actually forms the tire tread to thoroughly smooth it and shape it to the core. In case of the spinning-rolls 147, the radially movable and in this case sliding support permits the operator to pass the rolls gradually over the surface of the side of the ring-core that is radially with respect to the ring core from the edge of the tread portion to the tire-edge, so as to gradually bring the sheeted fabric which is to form the rubber tire into contact with the sides of the ring-core. In case of the pivoted cutters 149 as well as in the case of the bead-applying roll 156, the radial movability of the support renders it possible to position the parts to the proper place for the work intended with different sized ring-cores.

The tread-forming-roll is mounted in brackets on the radially and transversely movable head 131. Its axis, when in operation, is parallel to the axis of the ring-core and its curvilinear shape in longitudinal section is made to correspond to the shape of the outer or tread portion of the ringe-core. It will thus be clear that after the operator has drawn a layer of rubber-coated canvas onto the ring-core, he can, by pressing the tread-forming-roll 141 against the fabric, smooth and shape the fabric on the core and get it free of captured air bubbles or wrinkles over its outer face. This action will be all the more efficient by reason of revolving the ring-core at high speed.

The spinning-rolls 147 are preferably mounted on ball-bearings or similar anti-friction mechanism for they revolve at high speed and exert considerable pressure on the fabric. They are laterally movable, that is to say they are movable toward and away from the plane of the ring-core and this movability I effect, in the case shown, by pivoting them at 146 on arms 144 mounted on pivots 143 on the head 131 A pair of grips or hand holds 142 on the arms 144 enables the operator to force the rolls 147 apart both when they are first applied to the ring-core and when they are withdrawn therefrom, in the backward motion, after their work is finished. The spinning-rolls are also shown as spring-pressed toward the plane of the ring-core by springs 145, here shown, diagrammatically, as leaf springs although, in practice, strong spiral springs will be used. These springs exert the pressure against the fabric for forming it against the sides of the core which would be exerted by the arm of the workman in case of a hand-tool or a hand-pressed roll. In consequence the work of these spring-pressed spinning-rolls is far more even and more rapid than in the case of a roll pressed against the core by hand. And it is of course understood that there may be substituted for the springs and as an equivalent therefor the more cumbersome device of a weight constantly tending to force the spinning-rolls, with considerable pressure, toward the ring-core. When then I say the spinning-rolls or their supports are laterally spring-pressed, I mean either spring or weight pressed laterally against the ring

core for; as before stated, a spring is the equivalent of a weight. In a broader aspect of my invention, however, I may employ mechanical instrumentalities, not the hands of the operator, other than springs or weights for pressing the spinning-rolls laterally against the ring-core. I shall, then, use the term "power-pressed" to cover generally not only springs and weights but other mechanical instrumentalities for pressing the spinning-rolls against the ring-core. When I refer to my spinning-rolls as laterally yielding and no more, I mean to include any source of power for pressing the spinning-rolls against the ring-core, even the comparatively inefficient and irregular power contained in the hands of the operator. While I have shown these spinning-rolls as disk-shaped throughout, it will naturally be understood that the disk-like or narrow character of the rolls is only essential at the periphery which is rounded and not sharp so as not to cut the fabric. By having the outer or working edge of the spinning-roll of a narrow or disk-shape or bead form, it follows that this working edge can effectually contact with the fabric at all portions along the sides of the ring-core. This would be impossible with a roller of the type shown at 141. On the other hand, the spinning-rolls are not so well adapted as the rolls 141 to shape the tread portion of the tire. It will be noted finally that I mount the spinning-rolls with their plane not at a right angle to but to recede at an acute angle from the plane of the ring-core. The fact is when the ring-core is rotating at high-speed, the centrifugal force tends to throw the fabric out at a right angle from the core-plane and unless the roller recedes in the manner shown, the fabric will become entangled with it. Besides the spinning-rolls, when mounted in this way, are found to have a better forming action on the fabric.

The action of the pivoted cutters 149 will be understood without much description. They are brought into position by turning the head 131 and forced together at the proper time to trim the edges of the fabric which has been applied to the ring-core.

The bead-applying rolls 156, 158 are mounted on the arms 155 which swing on the arms 154. The ordinary bead, such as is used in forming a clencher tire, being put into place on one or more layers of fabric which have already been applied to the ring-core, the rolls 156, 158 are swung into place and press the bead firmly into position as the ring-core rotates.

I have shown in Fig. 9 the type of ring-core which will be used for clencher tires. But, clearly, my machine can also be used to make tire-shoes of the inextensible-edge type. To this end I use a collapsible ring-core, the shape of which in cross-section is shown in Figs. 12, 12^a, 12^b and 12^c. The fabric in the several stages of application is also shown in these several figures. The ring-core has two lateral grooves which furnish lodgment for the heavy inextensible edge which is employed in this class of tires. It will be understood that one or more layers of fabric are applied to the ring-core, that the inextensible selvages are then placed into the lateral grooves by hand and that the outer layers or plies of fabric are finally applied over the inextensible selvage. In this case the pivoted cutter 149 may be replaced by a knife in the hands of the workman, since the edge of the lateral groove will act as a guide and that the bead-applying rolls 156, 158 are dispensed with. The tread-forming-rolls 141 and the spinning-rolls 147 are alone used.

Before describing the operation of the device, attention is directed to the fact that the machine is so constructed that there are two cores on which separate workmen can simultaneously work and place fabric, these being placed diametrically opposite to each other, as shown in Fig. 1, and each core is provided with its appropriate mechanism all driven from the same source of power.

The operation of my machine will now be reasonably clear. As I have before explained, a ring-core supplied with some adhesive material on its exterior portion is placed upon the chuck while the speed-shifting lever is in position to hold the speed-mechanism out of action. Thereupon, by properly rotating and locking the rotary support for the stock-rollers, a given stock-roll is brought opposite to the ring-core and the end of the fabric thereon is pasted against the ring-core. The slow-speed mechanism being now brought into action, the ring-core slowly rotates, making a single turn in about ten seconds, drawing the rubber-coated fabric from off the stock-roll and around the tension and stretching-rolls. It results that one round of fabric is now applied under uniform tension to the ring-core. Thereupon the speed gear is put out of action, the ring-core stops moving, and the operator cuts the rubber-coated fabric across to separate the round of fabric which is on the ring-core from the fabric which yet remains on the stock-roll.

The fast-speed mechanism is now brought into play. The tread-forming-roll 141 is then brought into action to shape and smooth the tread-portion of the fabric against the outer periphery of the ring-core. The proper pressure is applied to the tread-forming-roll 141 by the devices which make it radially movable, that is by the hand-wheel 124 which radially moves the carriage 121 and 131. The parts of the tire which will ultimately lie under the tread having

been shaped and the fast-speed gears still being kept in action, the carriage 131 is rotated to juxtapose the spring pressed spinning-roll 147 to the ring-core. The operator forces these rolls apart against the action of the springs. At first the spinning-rolls are positioned to act upon the edges of the tread portion of the tire-shoe. But they are gradually moved radially by the operator by operating the hand-wheel 124 so that they pass over the side portions of the tire-shoe as illustrated in Figs. 12[a], 12[b] and Fig. 9. Thus the entire tire-shoe is gradually shaped to the ring-core. The operator now forces the spinning-rolls apart and operates the wheel 124 in the reverse direction to withdraw them from reach of the ring-core but without touching the fabric in this reverse motion.

A single layer of canvas having been applied to and smoothed and shaped upon the ring-core, it will be obvious that the operator will bring the slow-speed mechanism into action, that he will now take his rubber-coated fabric from a second stock-roll and will apply this upon the layer of fabric already on the ring-core in precisely the same way as the first layer of fabric was applied to the ring-core itself. But, by the provision of the two stock-rolls having the rubber-coated canvas thereon constituted of strips cut on the bias, it will be plain that it will be easy to arrange matters so as to have the threads of the canvas layer first applied at an angle to the threads of the canvas layer next applied. This is necessary to make the best type of tire. Two or more layers of canvas having been applied, the cutter may be brought into action to trim the edges of the tire. Thereupon the bead is put in place and the bead-applying rolls are brought into action. Finally, several more layers of fabric with their threads crossed are applied to the ring-core, precisely as in the case of the layers originally applied.

I may say in conclusion that whereas an operator can make seven or eight tires a day by hand, he can make from forty to sixty a day by my machine and make them better than they can be made by hand.

I claim,—

1. An open tire-shoe making machine comprising the combination of a power-driven ring-core, and a pair of stock-rolls for carrying strips of sheeted fabric having their threads at alternate angles for alternate application to the core, substantially as described.

2. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a transversely movable support, and a pair of stock-rolls for carrying strips of sheeted fabric having their threads at alternate angles mounted on the support for alternate juxtaposition to the ring-core, substantially as described.

3. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a rotary support, and a pair of stock-rolls for carrying strips of sheeted fabric having their threads at alternate angles, mounted on the support for alternate juxtaposition to the core, substantially as described.

4. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally spring-pressed toward the core, and a spinning-roll mounted on the support for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

5. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally spring-pressed toward the core, and a spinning-roll mounted on the support at a receding angle to the plane of the core for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

6. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally spring-pressed toward the core, and a spinning-roll having a rounded disk-shaped working edge mounted on the support for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

7. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally spring-pressed toward the core, and a spinning-roll having a rounded disk-shaped working edge mounted on the support at a receding angle to the plane of the core for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

8. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially movable thread-forming-roll for shaping the outer portion of the tire, a radially moving support laterally spring-pressed against the core, and a spinning-roll mounted on the support to pass radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

9. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core and a transversely and radially movable support carrying [illegible]read-forming-roll for shaping the out[illegible]tion of the tire and a laterally yielding spinning-roll for passing radially over the sides of the tire-shoe to

shape the sheeted fabric on the core, which rolls are alternately juxtaposed to the ring-core, substantially as described.

10. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, and a radially movable, rotary support carrying a tread-forming-roll for shaping the outer portion of the tire-shoe and a laterally yielding spinning-roll for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

11. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of sheet-fabric, a ring-core, a slow-speed mechanism for actuating the core when receiving fabric from the stock-roll, a forming-roll, a fast-speed mechanism for actuating the ring-core during the operation of the forming-roll, and speed-changing mechanism, substantially as described.

12. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of sheet-fabric, a ring-core, a slow-speed mechanism for actuating the core when receiving fabric from the stock-roll, a radially moving spinning-roll for passing radially over the side of the tire-shoe to shape the fabric on the core, fast-speed mechanism for actuating the ring-core during the operation of the spinning-roll, and speed-changing mechanism, substantially as described.

13. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of sheet-fabric, a ring-core, a slow-speed mechanism for actuating the core when receiving fabric from the stock-roll, a radially moving support laterally power-pressed against the ring-core, a spinning-roll mounted on the support at a receding angle to the ring-core to pass over the side of the tire-shoe to shape the fabric on the core, a fast-speed mechanism for actuating the ring-core during the operation of the spinning-roll, and speed-changing mechanism, substantially as described.

14. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of sheeted fabric, a ring-core, a slow-speed mechanism for actuating the core when receiving fabric from the stock-roll, a radially and transversely movable support, a tread-forming-roll and a laterally yielding spinning-roll for passing radially over the sides of the tire-shoe mounted thereon, fast-speed mechanism for actuating the ring-core during the operation of the tread-forming and spinning-rolls, and speed-changing mechanism, substantially as described.

15. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a stock-roll for carrying a spiral winding of rubber-coated fabric and muslin, or the like, and a yieldingly mounted take-up roll frictionally engaging the material on the stock-roll, whereby the muslin is taken up as the rubber-coated fabric is drawn onto the ring-core, substantially as described.

16. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of sheeted fabric, a tension-roll, a power-driven ring-core for drawing the sheeted fabric under tension from the stock-roll, and a stretching-roll provided with divergent, spirally arranged sets of grooves between the tension roll and the ring-core, whereby the longitudinal creases are taken out of the fabric in its passage to the ring-core, substantially as described.

17. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of sheeted fabric, a tension device, a power-driven ring-core for drawing the fabric under tension from the stock-roll, and a stretching-roll between the tension device and ring-core, whereby the longitudinal creases are taken out of the fabric and it is smoothly and evenly applied to the ring-core, substantially as described.

18. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a movable head, and two sets of rolls for alternate juxtaposition to the core, each set comprising the stock-roll for carrying a strip of sheeted fabric having its threads at alternate angles, and a tension-roll over which the fabric passes on its way to the core, substantially as described.

19. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a movable head, and two sets of rolls for alternate juxtaposition to the core, each set comprising a stock-roll for carrying a strip of sheeted fabric having its threads at alternate angles, and a stretching-roll provided with divergent, spirally arranged sets of grooves over which the fabric passes on its way to the core, substantially as described.

20. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a movable head and two sets of rolls for alternate juxtaposition to the core, each set comprising a stock-roll for carrying a strip of sheeted fabric having its threads at alternate angles, a tension-roll and a stretching-roll over which the fabric passes on its way to the core, substantially as described.

21. An open tire-shoe making machine comprising the combination of two power-driven ring-cores, a rotary head, a pair of stock-rolls mounted thereon for alternate juxtaposition to one core carrying sheeted fabric with their threads at alternate angles, and another pair of stock-rolls mounted on

the head for alternate juxtaposition to the other core also carrying sheeted fabric with their threads at alternate angles, substantially as described.

22. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally power-pressed toward the core, and a spinning-roll mounted on the support for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

23. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally power-pressed toward the core, and a spinning-roll mounted on the support at a receding angle to the plane of the core for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

24. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally power-pressed toward the core, and a spinning-roll having a rounded, disk-shaped working edge mounted on the support for passing radially along the sides of the tire-shoe to shape the sheeted fabric, on the core, substantially as described.

25. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally power-pressed toward the core, and a spinning-roll having a rounded disk-shaped working edge mounted on the support at a receding angle to the plane of the core for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

26. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core for drawing the sheet-fabric from the source of supply in a flat condition, a radially sliding support, and a laterally yielding spinning-roll on the support for passing radially along the sides of the ring-core to curve and shape the sheeted fabric thereon, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILL C. STATE.

Witnesses:

R. M. Lemieux,

O. W. Myers.

Plaintiff's Exhibit No. 3—Patent on Defendant's Machine.

(Thropp & De Laski No. 1,119,326.)

26

J. E. & P. D. THROPP & A. DE LASKI.

MACHINE FOR MAKING OR BUILDING UP PNEUMATIC TIRES.

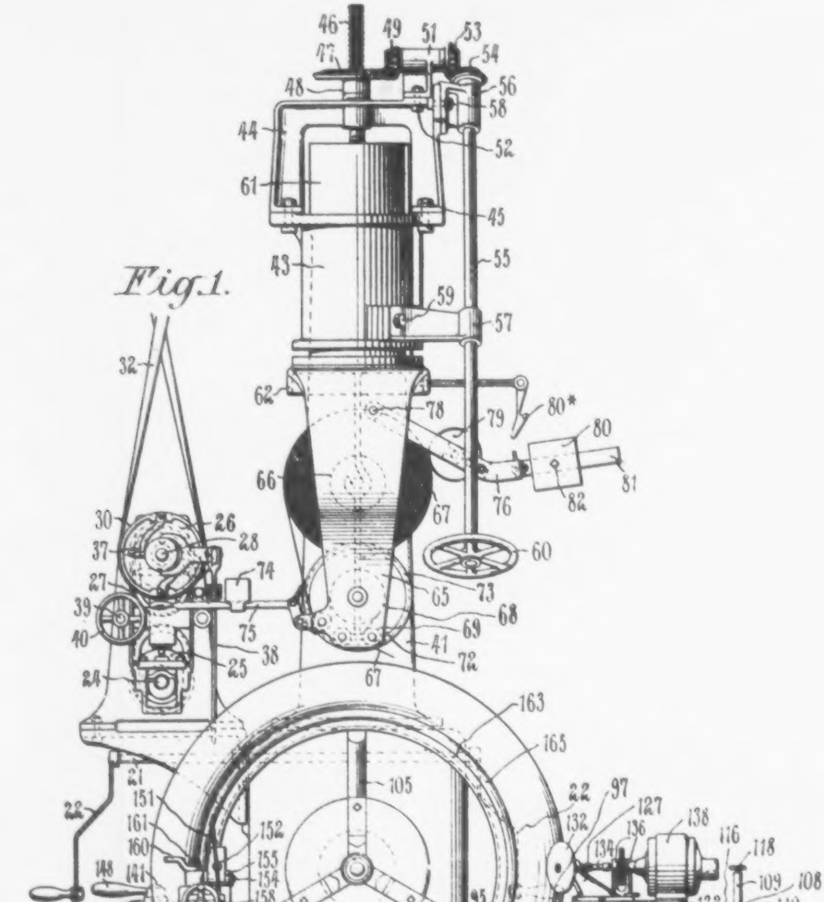
APPLICATION FILED JAN. 24, 1912.

1,119,326.

Patented Dec. 1, 1914.

7 SHEETS-SHEET 1.

Fig. 1.



Witnesses:

Inventors:

J. E. & P. D. THROPP & A. DE LASKI.

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7 SHEETS—SHEET 2.

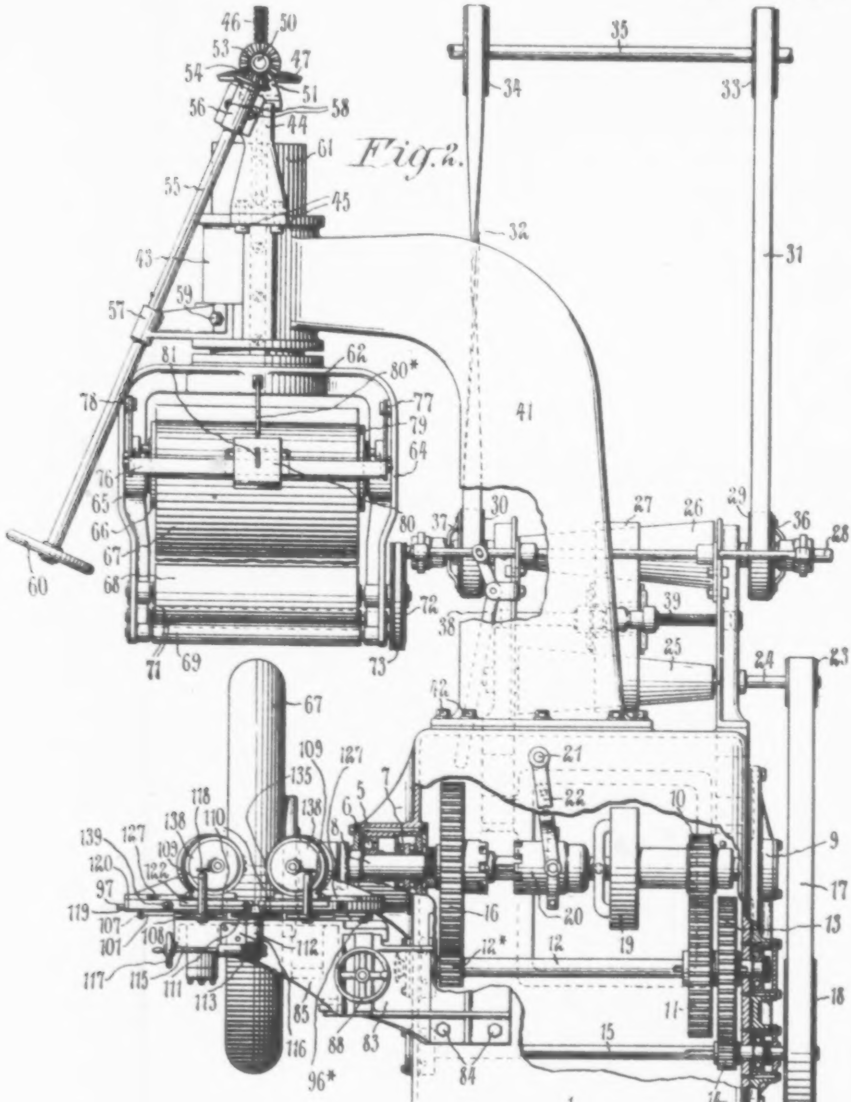

Fig. 2.

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and Albert de Laski
by their attorney
Browne Seward

J. E. & P. D. THROPP & A. DE LASKI.

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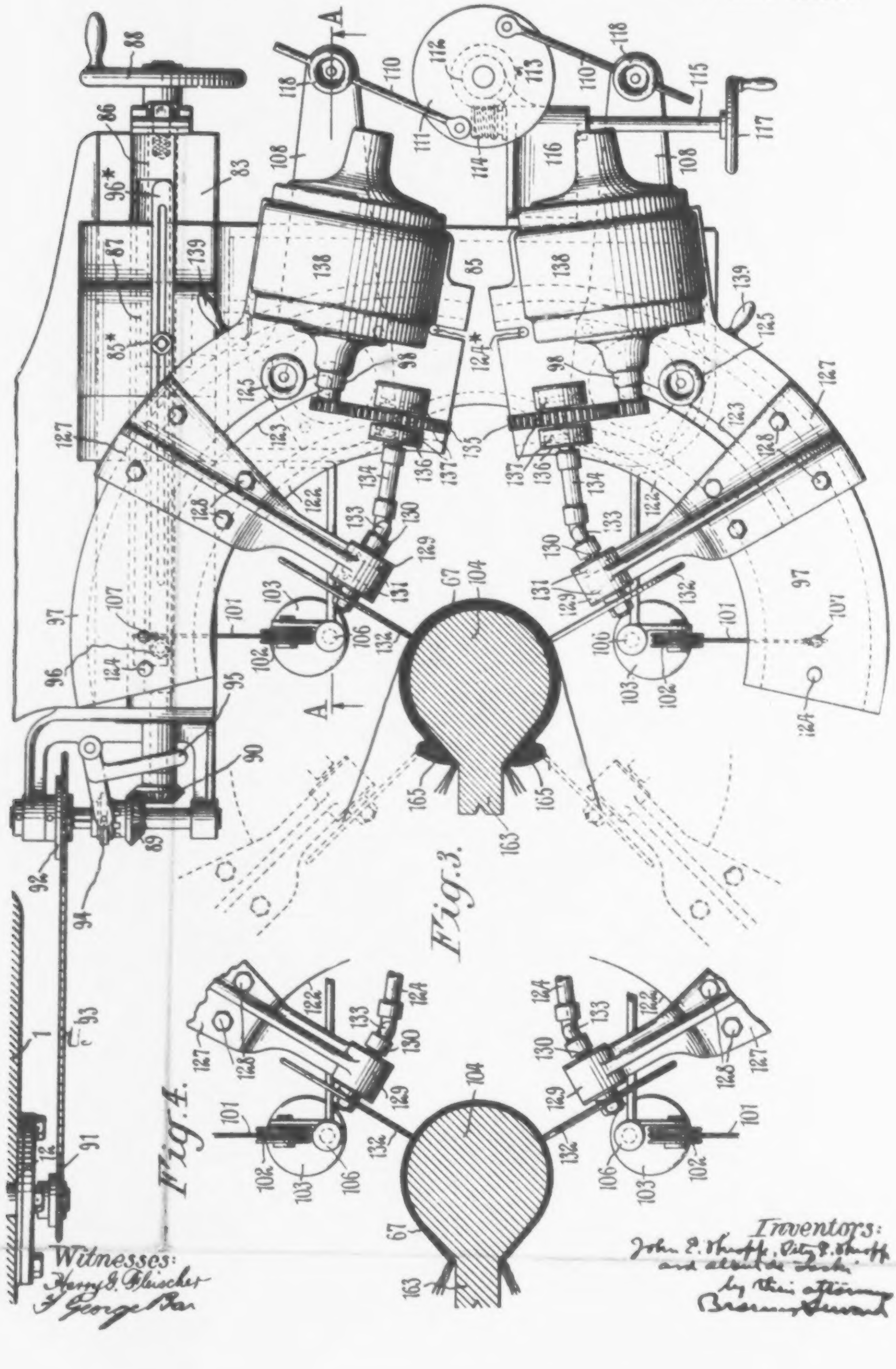
7 SHEETS—SHEET 3.



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by their attorney
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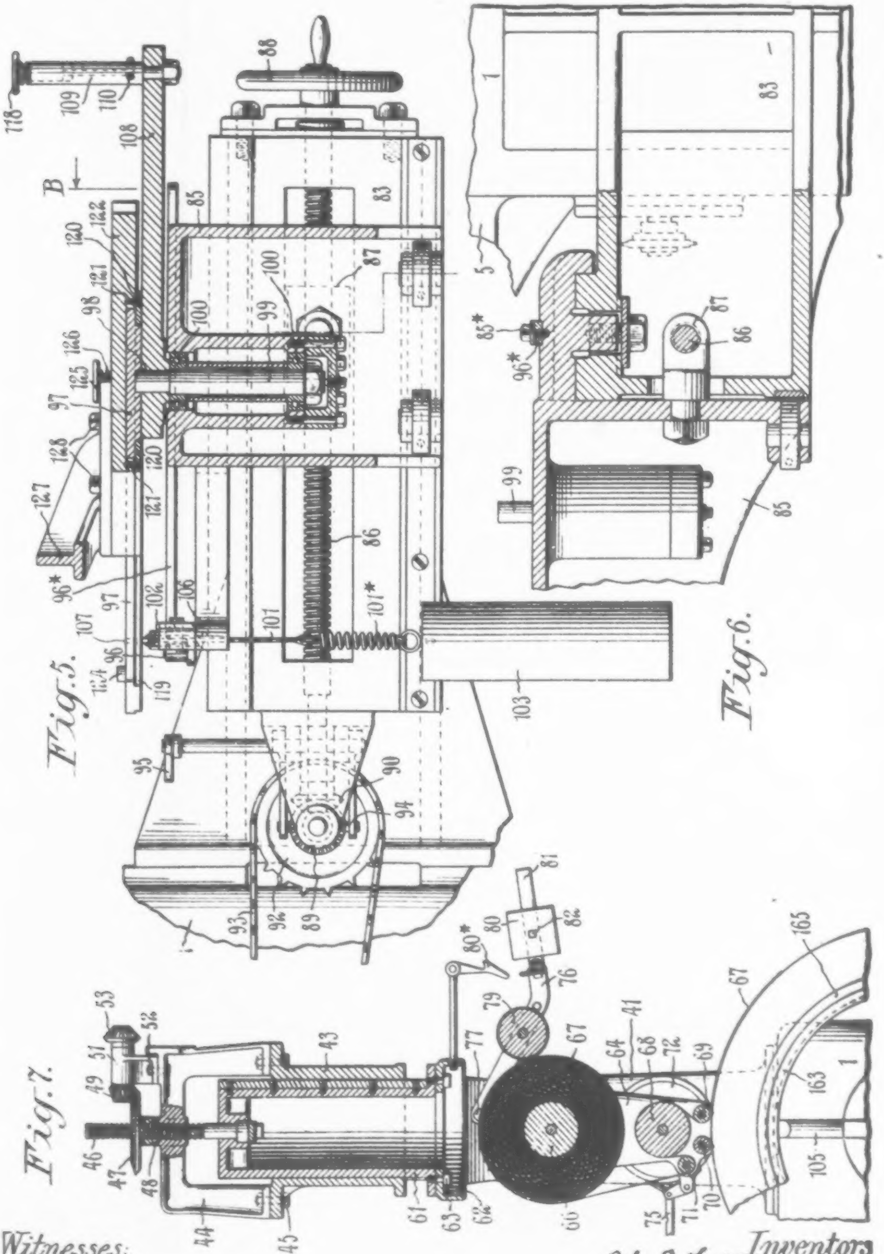
7 SHEETS—SHEET 4.



Witnesses:

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John E. Thropp, Peter D. Thropp and Albert de Laski

by their attorneys

Brown & Seward

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7 SHEETS—SHEET 5.

Fig. 8.

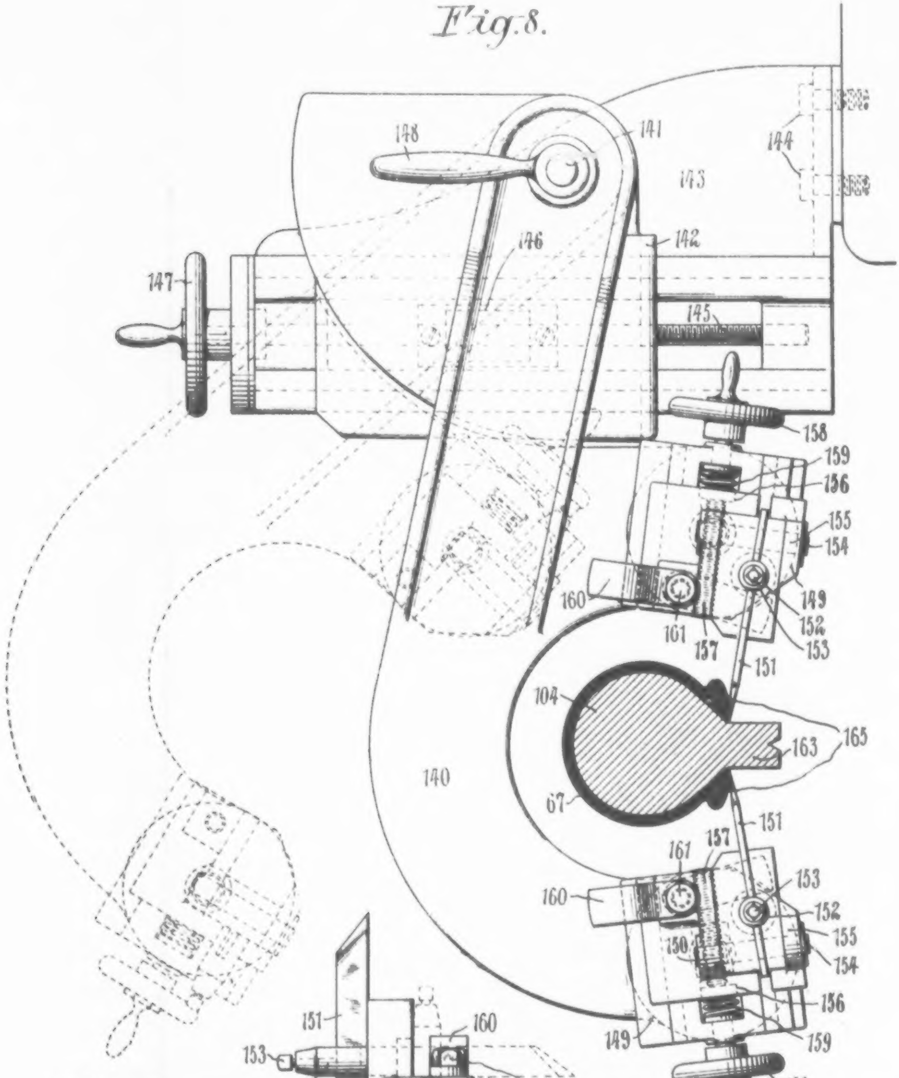
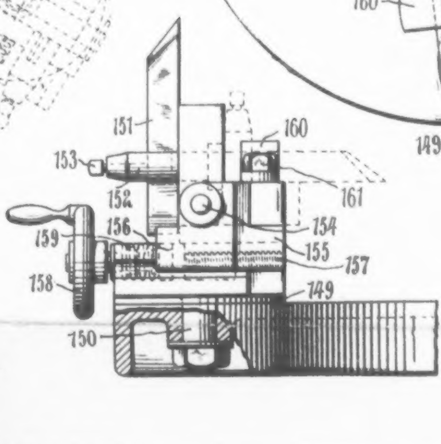


Fig. 9



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7 SHEETS-SHEET 6.

Fig. 10.

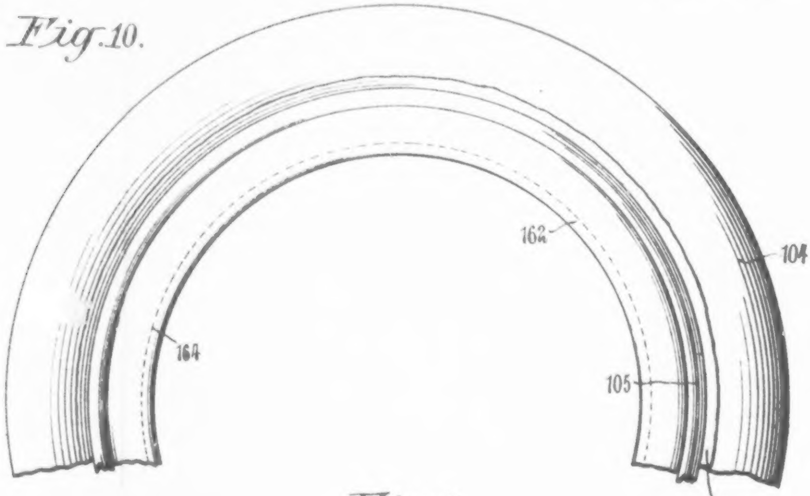


Fig. 11.

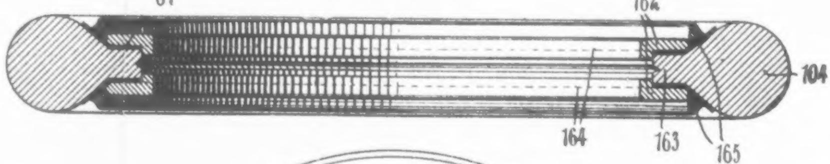


Fig. 12.

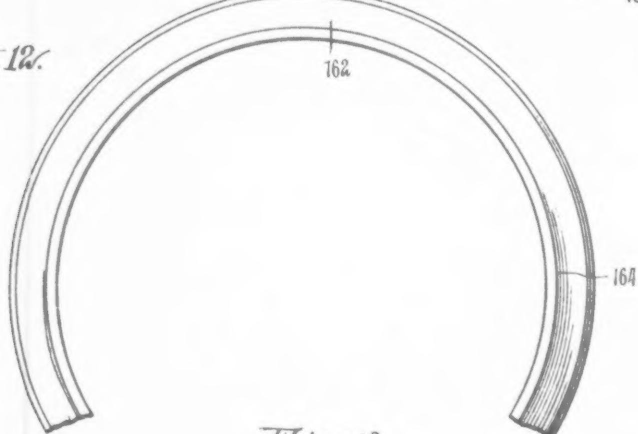
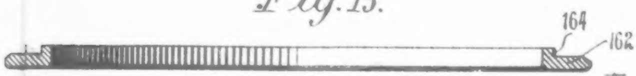


Fig. 13.



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MACHINE FOR MAKING OR BUILDING UP PNEUMATIC TIRES.

APPLICATION FILED JAN. 24, 1912.

1,119,326. Patented Dec. 1, 1914.

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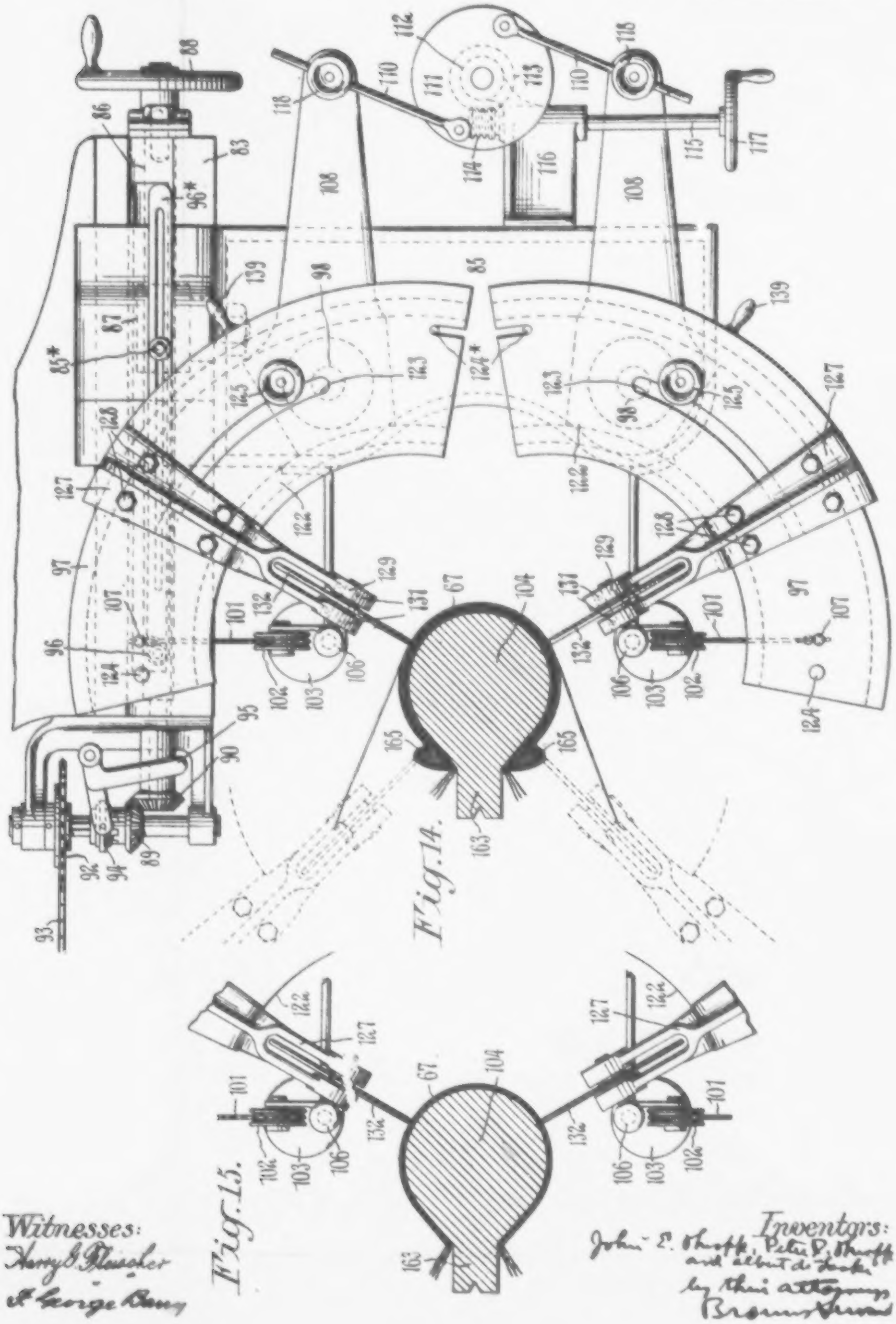

Fig. 14.

Fig. 15.

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UNITED STATES PATENT OFFICE.

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MACHINE FOR MAKING OR BUILDING UP PNEUMATIC TIRES.

1,119,326. Specification of Letters Patent. Patented Dec. 1, 1914.

Application filed January 24, 1912. Serial No. 673,069.

To all whom it may concern:

Be it known that we, JOHN E. THROPP, PETER D. THROPP, and ALBERT DE LASKI, citizens of the United States, said JOHN E. THROPP and PETER D. THROPP being residents of Trenton, in the county of Mercer and State of New Jersey, and said ALBERT DE LASKI being a resident of Weehawken, in the county of Hudson and State of New Jersey, have invented a new and useful Machine for Making or Building Up Pneumatic Tires, of which the following is a specification.

This invention relates to a machine for making or building up pneumatic tires, and more particularly to making so-called shoes or casings for covering the inner tube in the type of pneumatic tires known as the double tube variety.

Among the objects of this invention are to provide a machine of this character which may be readily manipulated by one operative, which will make tires much more rapidly and much more uniformly than they can be made by hand, and which will occupy a minimum of floor space.

Other objects are to provide certain improvements in the form, construction and arrangement of the several parts whereby the greatest known perfection of tire building is attainable, and the above mentioned objects effectively carried out.

A practical embodiment of our invention is represented in the accompanying drawings, in which—

Figure 1 represents a front view of the entire apparatus, Fig. 2 represents a side view thereof, parts being broken away, Fig. 3 represents a detail plan view of the devices for forming the fabric about the core, the latter being shown in section, Fig. 4 represents a detail view showing the devices for forming the fabric layers, acting upon the first plies of the same, Fig. 5 represents an enlarged detail section taken in the plane of the line A—A of Fig. 3, looking in the direction of the arrows, Fig. 6 represents a detail section taken in the plane of the line B of Fig. 5 looking in the direction of the arrow, Fig. 7 represents a detail vertical section showing the head, supply roll and adjacent parts, Fig. 8 represents an enlarged detail plan view showing the cutters for trimming the edges of the material, the core being shown in section, Fig. 9 represents a detail side elevation of one of the cutting devices, parts being broken away, Fig. 10 represents a side elevation, partly broken away, showing the bead core placing ring on the core, Fig. 11 represents a section through the parts shown in Fig. 10, Fig. 12 represents a side view partly broken away of the bead placing ring, Fig. 13 represents a section therethrough, Fig. 14 represents a view similar to Fig. 3, showing a modified form of forming rolls, and Fig. 15 represents a view similar to Fig. 4, showing a modified form of forming rolls.

The apparatus comprises a casing denoted by 1, which is secured to a suitable base 2 by bolts 3, which base 2 may, in turn, be secured at any desired place by fastening devices passing through holes 4. This casing 1 is provided at one side with a suitable boss 5 fitted with ball bearings 6 and thrust bearings 7 in which is journaled a rotatable shaft 8, the inner end of which shaft extends through the casing and is journaled in the other side thereof at 9, while the outer end projects therefrom and is fitted to receive the core upon which the tire is to be built, as will be hereinafter described.

The shaft 8 is provided with a spur gear 10 rotatably mounted thereon, which spur gear 10 is fitted to engage a spur gear 11 mounted against rotation on the jack shaft 12 journaled in the casing 1 below the shaft 8, and which shaft 12 also carries a spur gear 13 mounted against rotation thereon and fitted to engage a pinion 14 mounted against rotation on a power driven shaft 15 journaled in the casing 1 below the shaft 12. The jack shaft 12 is provided at its front end with a pinion 12* mounted against rotation thereon and fitted to engage a large gear 16 rotatably mounted on the shaft 8. The shaft 15 is positively driven through the belt 17 which engages the pulley 18 secured against rotation to the end of the shaft 15, and which belt 17 is itself driven from a suitable source of power, as will be hereinafter fully described. Mounted against rotation on the shaft 8 intermediate the gear 10 and gear 16 is a friction cone

clutch 19 and a jaw clutch 20 arranged to be operated from a cross shaft 21 to which is secured a pair of handles 22 for convenient manipulation thereof.

When the friction clutch 19 is thrown into locking position, it holds the small gear 10 against rotation on the shaft 8 and the said shaft will consequently be driven at a relatively high speed through the driven shaft 15 and the train of gears 14, 13, 11, 10. When the jaw clutch 20 is thrown into locking position, the large gear 16 will be fixed against rotation on the shaft 8 and the latter will be driven at a relatively slow speed through the driven shaft 15 and the train of gears 14, 13, 12*, 16. When the shaft 8 is driven at relatively high speed as first mentioned, the large gear 16 will rotate idly on the shaft 8; and when the shaft 8 is driven at low speed the small gear 10 will rotate idly thereon. The handles 22 may be thrown in such a position that neither clutch is in locking engagement, in which case the gears 10 and 16 will be idly rotated on the shaft 8 while the latter remains still. The belt 17 also engages a small pulley 23 mounted against rotation on a shaft 24, which shaft carries a variable cone 25 which itself is driven from a steady speed cone 26 by a sliding belt 27. The steady speed cone 26 is mounted on a shaft 28 which is provided at either end with pulleys 29, 30, which pulleys are connected by means of a straight belt 31 and crossed belt 32, respectively, to pulleys 33, 34, fixed on a shaft 35 driven from a suitable source of power, not shown. A pair of clutches 36, 37, are mounted on the shaft 28 and arranged to be operated by a lever 38 so as to throw either the pulley 29 or the pulley 30 into driving engagement with the steady speed cone 26. When the pulley 29 is in driving engagement with the cone 26, the latter is driven in one direction, and when the pulley 30 is in locking engagement with the said cone it is driven in the reverse direction owing to the crossing of the belt 32.

A rod 39 has a screw and nut engagement with the belt 27, and is provided with a hand wheel 40 for sliding the belt 27 in either direction on the cones 25 and 26 for varying the speed of the cone 25 and hence varying the speed of the driven shaft 15 in the casing 1.

From the above described arrangement of belts, pulleys, cones, shafts, clutches, and gears, it will be seen that the shaft 8 can be rotated in either direction and at varying speeds. It will also be seen that with a certain fixed speed for the driven shaft 15, the shaft 8 may be rotated either forward or backward at a high and a low speed. Thus there is provided suitable arrangements for adapting the rotation of the shaft 8 both in direction and speed to the most precise demands of any part of the operation of building the tire.

The apparatus also includes mechanism for supplying material of which the tire is to be constructed to the core upon which the latter is to be formed, which mechanism, as shown in the drawings, comprises an overhanging stanchion 41 firmly secured to the top of the casing 1 by bolts 42. This stanchion 41 has a hollow cylindrical head 43 vertically disposed directly above the core to be hereinafter described. This head 43 has a frame support 44 of inverted U-shape secured to the top of the head by bolts 45, which frame 44 has a centrally disposed vertical hole fitted to receive a screw 46. This screw 46 has a screw threaded engagement with a miter gear 47 supported on top of the frame 44 by an interposed thrust bearing 48, which miter gear 47 is in engagement with a miter pinion 49 secured to one end of a short transverse shaft 50 horizontally journaled in a support 51 bolted to the top of the frame 44 as at 52. A second miter pinion 53 is secured to the other end of the shaft 50, and it, in turn, is in engagement with a third miter pinion 54 secured to the upper end of a rod 55. This rod 55 is rotatably mounted in a pair of brackets 56, 57, fastened to the side of the frame 44 and the hollow head 43 by bolts 58 and 59 respectively; and is provided with a hand wheel 60 fixed to its lower end for convenient manipulation by the operative.

A hollow cylinder 61 is fitted to reciprocate vertically in the head 43 and is secured at its upper end to the screw 46. To the lower end of this cylinder 61 is fastened a frame 62 by means of screws 63, which frame 62 has a pair of downwardly extending arms 64, 65. The arms 64 and 65 have suitable bearing supports for the stock roll 66, which is arranged to carry the fabric 67 from which the tire is to be constructed; the friction or resistance roll 68 and guide rollers 69, 70, 71. The friction roll 68 is preferably composed of some material which has a surface of such a nature as to cause considerable friction between it and the fabric of which the tire is to be composed, wood being found very suitable for this purpose. The guide rollers 69, 70, 71, are preferably composed of metal, such as steel, and are so located that the distance between the axes of any two of them is less than the diameter of the resistance roll 68.

The resistance roll 68 is provided at one end with an enlarged drum 72 fitted with a brake band 73 which is arranged to be caused to grip the drum 72 with varying degrees of friction by means of the weight 74 slidably mounted upon the notched bar 75.

A rocking frame 76 is pivoted to the arms 64 and 65 of the frame 62 at 77 and 78, re-

spectively, in which rocking frame is suitably journaled a take-up roll 79 adapted to receive the cloth which is commonly wound on the stock roll 66 with the tire fabric 67. This take-up roll 79 is caused to engage the fabric 67 on the roll 66 with varying degrees of friction by means of the weight 80 which is slidably mounted on a rod 81 secured to the outer edge of the rocking frame 76, and arranged to be fastened at various positions along the rod 81 by a set screw 82. A hook 80* is located above the frame 76 and arranged to engage the latter when it is swung upwardly for the purpose of holding the roll 79 out of engagement with the fabric 67 on the stock roll 66. The frictional engagement of the take-up roll 79 with the stock roll 66 causes the former to be rotated by the latter and hence to take up the cloth as the fabric is unwound from the roll 66.

The parts just described as being mounted in the frame 62 are arranged to be vertically adjusted as a whole through the engagement of the frame 62 with the cylinder 61, which, in turn, is secured to the screw 46. It will be seen, from the description, that by rotating the hand wheel 60, the miter gear 47 will be turned upon the screw 46 and will either raise the latter or lower it, owing to the well known action of the screw and nut principle. This raising and lowering of the screw 46 will carry the frame 62 and all its appurtenances with it. While we have shown a manually operated screw and nut for the purpose of adjusting these parts, we do not at all intend to limit the structure to such a mechanical arrangement as any well known means for effecting this result either by hand or by power is perfectly suitable for the purpose.

The machine also includes apparatus for mechanically building or forming the tire material onto the core and this apparatus, in the form shown in the drawings, comprises a laterally extending bracket 83 which is firmly secured to the casing 1 by bolts 84.

A laterally extending carriage 85 is mounted on the bracket 83 to slide transversely along the front of the casing 1. This sliding movement of the carriage 85 is effected by a screw 86 which is threaded into a nut 87 in the carriage 85, and which screw 86 is adapted to be rotated manually by a hand wheel 88 and mechanically by miter gears 89 and 90 driven from the shaft 12 through sprockets 91 and 92, chain 93, and clutch 94. The clutch 94 is provided with a knock-off 95 so located as to be engaged by a roller 96 fixedly secured on the end of a slide 96*, which slide has a pin and slot engagement with a set screw 85* on the carriage 85, for securing the said slide in any desired longitudinal adjustment. The engagement of the roller 96 with the knock-off 95 may be so timed that the clutch 94 will be disengaged from the miter gear 89 and hence the screw 86 cease to be power driven at any desired point in the movement of the carriage 85. It will be understood that the carriage 85 may be reciprocated at any point by the manual operation of the hand wheel 88. A pair of similar curved arms 97 are fulcrumed at 98 in the carriage 85 by pivots 99 mounted in suitable ball bearings 100 as clearly shown in Fig. 5. The arms 97 are secured by means of cords 101 passing over pulleys 102 to weights 103, which weights tend to draw the arms 97 toward each other and hence toward the core 104 upon which the tire is to be built: which core is supported by an adjustable spider 105 fixed against rotation on the protruding end of the shaft 8 whereby the core 104 is caused to rotate with and at the speed of the shaft 8. If desired, coil springs 101* may be secured to the cords 101 and weights 103 to obviate any jerkiness in the action of the said weights.

The pulleys 102 are mounted on brackets 106 at a distance from the fulcrum points 98 of the arms 97 substantially equal to the distances from the said fulcrum points to the points 107 at which the ends of the cords 101 are secured to the arms 97, thus insuring that the weights will have substantially the same pull on the arms throughout the swing of the latter about their fulcrums.

The arms 97 are each provided with a rearward extension 108, which extensions in turn have at their extremities standposts 109 provided with transverse holes fitted to receive connecting rods 110 secured, at diametrically opposite points, to a circular disk 111 which has a hub 112 provided with a worm gear 113 fitted to engage a worm 114 fixed to the end of a transverse rod 115 journaled in a lug 116 on the carriage 85, and provided at its outer end with a hand wheel 117 for manual operation. The standposts 109 are interiorly screw threaded for engagement with set screws 118 fitted to engage the connecting rods 110 for locking them in any desired position in the standposts 109.

The arrangement of parts just described permits the operator to lock the connecting rods 110 in the standposts 109 by means of the set screws 118, and then by manually operating the hand wheel 117 swing the arms 97 about their fulcrum points 98 in either direction. The advantage of this structure will be fully described in setting forth the operation of the machine.

The curved arms 97 are undercut as clearly shown at 119, Fig. 5, whereby they are fitted to receive curved plates 120 secured by means of screws 121 to the curved

slides 122 mounted to oscillate arcuately on the curved arms 97. These slides 122 are provided with curved slots 123 fitted to receive the pins 124 which are adapted to abut against the inner ends of the slots 123 when the slides 122 have been swung to the limit of their outward movement, thus preventing further movement of the said slides 122, while pins 124* limit their inward movement. The slides 122 are further provided with set screws 125 which are arranged to be screwed down against the tops of the arms 97 for locking the slides 122 in any position on the said arms. These set screws 125 may be provided with locking springs 126 for preventing the accidental loosening of the said set screws.

Bracket arms 127 are securely fastened to the outer ends of the curved slides 122 by screw bolts 128, and extend inwardly in substantially a radial direction from the said plates. The bracket arms 127 terminate in hollow heads 129 in which are journaled shafts 130 by means of suitable ball bearings 131, which shafts 130 are provided on their outer ends with disk shaped forming rolls 132 secured against rotation thereon. These disk-shaped forming rolls 132 are so mounted that their operating face or edge, which is adapted to engage the material on the core, is at the center of the circle through an arc of which the slides 122 are mounted to oscillate, thereby permitting the slides 122 to be moved and the angle of engagement of the disk rolls 132 with the material on the core to be varied, without moving the operative face of the said rolls. The shafts 130 are connected by means of universal joints 133, shafts 134 and trains of gears 135, partly supported by brackets 136 mounted on the slides 122 and having suitable ball bearings 137, with electric motors 138 also mounted on the curved slides 122 and arranged to be supplied with electricity from any convenient source.

The slides 122 may be provided with handles 139 for the convenient manual sliding thereof. The curved arms 97 carrying the slides 122, brackets 127 and forming rollers 132, are so positioned with respect to the core 104 that the forming rolls 132 will engage the said core considerably before the arms 97 have swung about their fulcrum points 98 to the limit of their inward movement.

The machine also includes mechanism for cutting or trimming off the superfluous edges of the tire material after it has been formed on the core 104, which mechanism comprises a horizontally disposed swinging arm 140 pivoted at 141 to a plate 142 slidably mounted on a boss 143 secured to the casing 1 opposite to the bracket 83 by screw bolts 144. The sliding plate 142 is fitted to reciprocate in a direction parallel to the reciprocation of the carriage 85, and the reciprocation of the plate 142 is effected by means of a screw 145 having a threaded engagement with a nut 146 secured to the plate 142, which screw 145 is rotated by means of the hand wheel 147. The arm 140 is provided at the pivot 141 with a clamping handle 148 screw threaded onto the pivot 141 for the purpose of locking the arm 140 in any desired position.

The arm 140 is bifurcated at its outer end to embrace the core 104 and is provided with a pair of swivel plates 149 mounted to rotate on the said arm 140 about the pivots 150, and carrying knives 151 clamped in upright studs 152 by set screws 153. These knives are fitted to swing in a vertical plane for about ninety degrees, *i. e.*, from the horizontal to the vertical, about pivots 154; and the knife supports 155 slidably mounted on the swivel plates 149 are provided with nuts 156 having screw threaded engagement with screws 157 arranged to be operated by hand wheels 158 for advancing the knives toward one another or withdrawing them from one another. Coil springs 159 may be placed between the knife supports 155 and the end of the swivel plates 149 for yieldingly holding the knives 151 at the limit of their projection. The knife supports may further be provided with swinging keepers 160 screw threaded therein at 161, which may be swung over the knives 151, as shown in dotted lines, Fig. 8, for the purpose of preventing the knives from moving from a horizontal position in case the direction of rotation of the core 104 should be reversed.

The machine also includes a pair of bead placing rings 162 fitted to engage the side faces of the tongue or rib 163 of the core 104 and also provided with shoulders 164 for engaging the inner edge of the core tongue 163 for holding the bead placing rings concentric with respect to the core 104. The bead placing rings extend far enough up on the sides of the core so as to provide seats for accurately locating the bead cores 165 of the tire, as will be hereinafter described.

Referring to the form shown in Figs. 14 and 15 all the parts are similar to those already described except that the electric motors 138, train of gears 135, brackets 136, and ball bearings 137 therein, shafts 134 and universal joints 133 are omitted. In this form, the heads 129 of the bracket arms 127 are bifurcated and the disk rolls 132 are centrally mounted therein on similar ball bearings 131.

In operation, referring to the preferred form having the power driven forming rolls, the material of which the tire is to be composed, commonly called friction fabric or duck, is placed upon the stock roll 66 with the customary interposed cloth; the said fabric being placed on the roll 66 in the al-

ready cut bias lengths of suitable size, according to the tire that is to be built, which are customarily supplied in tire manufacture; but it is not necessary to place these strips of friction fabric in any particular order as to their cut. The advance edge of the friction fabric is passed under the guide roll 71, over the friction roll 68 and under either of the guide rolls 69 and 70, and pressed firmly upon the periphery of the core 104. At the same time, the advance edge of the interposed cloth is wrapped about the take-up roll 79 which is permitted to frictionally engage the fabric 67 on the roll 66. The weight 74 is suitably adjusted on the rod 75 to cause the desired resistance to rotation of the roll 68. The hand wheel 60 may be rotated so as to depress the frame 62 and its appurtenances until they are the desired distance away from the periphery of the core 104. The belt 27 on the change speed cones 25, 26, may be moved to the desired position so as to give the proper surface speed to the periphery of the core; either clutch 36 or 37 may be thrown in by the lever 38 so as to provide the desired rotation to the driven shaft 15; after which the jaw clutch 20 may be thrown into driving engagement for rotating the shaft 8 at low speed. As the shaft 8 is rotated, it will, in turn, rotate the core 104 drawing the friction fabric off of the stock roll 66, and stretching the latter tightly about the periphery of the core 104. It will be seen that in preparing for this operation, the resistance on the roll 68 may be varied so as to get exactly the desired amount of stretching in the friction fabric on the periphery of the core; and that this stretch or tension will be exactly uniform throughout the circumference of the core, and may be much greater than that possibly attained by the strongest operative. After one layer of fabric has been thus stretched completely about the periphery of the core, it may be formed down about the sides of the core as follows: With the set screws 118 locking the connecting rods 110, the hand wheel 117 may be turned so that the arms 97 are spread away from the core 104 a sufficient distance to permit the arms to be advanced toward the core radially with respect thereto by means of the hand wheel 88 without engaging the periphery of the core. The hand wheel 88 may then be rotated, advancing the arms 97 to the desired position, after which the hand wheel 117 may be rotated so as to permit the arms 97 to move toward one another until the disk forming rolls 132 engage the friction fabric on each side of the core at about the point where the fabric ceases to show its stretch due to the previous action of drawing it on the core. The clutch 94 may now be thrown into operative position to drive the screw 86, and the friction clutch 19 may be thrown into operative position to drive the shaft 8 and hence the core 104 at high speed; at the same time the electric motors 138 may be started at a speed sufficient to rotate the disk rollers 132 at a peripheral speed greater than the peripheral speed of that part of the core which they engage. The set screws 118 will be loosened so as to permit the arms 97 to act under the influence of the weights 103.

As the core is rotated, the disk forming rolls will advance radially across the side thereof due to the action of the power driven screw 86, thus forming the fabric tightly about the sides of the core. The knock-off 95 will disengage the clutch 94 before the disk forming rolls 132 have gone completely down to the tongue of the core and the rolls may be fed the slight remaining distance by the hand wheel 88. After the first sheet of fabric has been thus formed completely about the core by the stretching and about the sides of the core by the disk forming rolls, a second sheet of fabric may be drawn onto the core in a manner precisely similar to that already described. If the second strip of fabric was placed on the stock roll 66 with its threads at right angles to the first strip of fabric, it will be stretched upon the core by rotating the latter in the same manner and in the same direction as previously described, using the low speed. If, however, the second strip happens to have been placed on the stock roll with its threads lying in the same direction as the threads of the first strip, it will be stretched upon the core by rotating the latter in the reverse direction, the reversal of rotation of the core being obtained by engaging the one of the two clutches 36, 37, which was not engaged in the former operation. After this second strip has been thus stretched on the periphery of the core superposed on the first strip of fabric, it may be formed down about the sides of the core by the disk forming rolls 132 as previously described. This operation may be repeated, care being taken to rotate the core in such a direction as to cause alternate layers of fabric to lie with their threads at right angles to adjacent layers, until the tire has been built up to the stage at which the bead cores should be placed in position. The bead placing rings 162 are now placed one on each side of the tongue of the core, as clearly shown in Fig. 11, it being customary to have one of the bead rings hanging on the shaft 8 between the casing 1 and the spider 105 in order that they may be ready for immediate use, or the bead placing rings may be split into semicircular form so as to be readily applied to the inner side of the core. The bead placing rings may be clamped temporarily in position on the core in any desired manner, and the previously formed bead cores 165 seated on the rings

and pressed in position on the fabric already stretched on the core, the bead placing rings absolutely insuring the accurate location of the bead core. It is also convenient to have one of the previously formed bead cores hanging on the shaft 8 between the casing 1 and the spider 105, or the bead placing ring and one bead core may be hung on the casing 1 in any desired position so long as they surround the shaft 8. After the bead cores have thus been placed in position, the bead placing rings may be removed from the core and another strip or layer of friction fabric stretched thereon and formed down about the sides of the core, as previously described. The roller 96 may now be set so as to engage the knock-off 95 as soon as the forming rolls 132 reach a point where they just touch the bead cores 165, so as to throw out the clutch 94 and stop the radial movement of the forming rolls, 132, with respect to the core. The point at which the roller 96 is set to effect the above mentioned result will vary according to the size of tire being operated upon. At this point, the operator may advantageously lock the set screws 118 on the connecting rods 110 and slowly feed the rolls 132 out across the top of the bead cores 165 to the outer edge thereof, thus causing the fabric to conform to the shape of the bead on top; the locking of the connecting rods 110 preventing the sudden engagement of the rolls 132 with the bead cores 165 from throwing the arms 97 violently apart; which action, if permitted, might cause damage to the tire.

When the disk rolls have been fed outwardly until they engage the outer edge of the bead cores, the operator siezes the handles 139 and rapidly swings the slides 122 arcuately toward the positions indicated in dotted lines, Fig. 3, so that the disk rolls may have a bearing almost at right angles to the lower face of the bead core. The set screws 118 are instantly loosened and the disk rolls fed ahead the short radial distance required to form the fabric down along the bottoms of the bead cores, by means of the hand wheel 88 connected to the feed screw 86, the weights 103 continuing to draw the rolls 132 laterally toward the tongue of the core. The requisite number of layers of fabric to complete the tire body or carcass are stretched and formed about the already placed layers and bead cores in a precisely similar manner; after which the swinging arm 140 carrying the knives 151 is swung around into the position shown in full lines, Fig. 8, and the knives fed up so as to engage the fabric at the lower point of the beads of the tire, by means of the hand wheels 158. The core 104 is then rotated by throwing in the low speed clutch 21, care being taken to rotate it in a direction appropriate to the cutting edges of the knives 151, and the said knives very rapidly trim off the superfluous edges of the fabric. If it should for any reason be desired to rotate the core in the reverse direction during the cutting operation, the cutting edges of the knives 151 can be reversed by loosening the set screws 153 and turning the knives 151 upside down; after which the keeper 160 may be swung over the knives, as shown in dotted lines, Fig. 8, to prevent the knives from rising from a horizontal position while the core is being rotated. During the cutting operation, the coil springs 159 will permit the knives to yield if they meet any obstruction, and will also have the effect of holding the knives in firm engagement with the layers of fabric to be cut or trimmed off. While the arm 140 is being swung into operative position, shown in full lines, Fig. 8, the knives can be in the vertical position, shown in full lines, Fig. 9, so that they cannot, by any chance, hit the fabric on the core above the beads.

In the above description of the mode of operation it has been stated that one fabric layer may be stretched on and then formed down around the sides of the core; this operation being repeated until the desired number of layers or plies are in position. However, it is a fact that it is perfectly feasible to stretch a plurality of layers or plies of fabric on the periphery of the core, one after the other; and then form the group thus placed down about the sides of the core at one operation. This naturally tends to save some time. It will further be noted that by means of the arcuate movement of the slides 122 on the curved arms 97, and the provision of the set screws 125 which serve to lock the said plates on the said arms, the angle at which the disk rolls 132 engage the fabric on the core for forming it down about the sides thereof, may be varied to a great extent. It is desirable to have this angle almost a right angle in order to get very firm pressure for thoroughly bonding the layers of fabric. This arcuate movement also permits the fabric plies to be perfectly formed about the bead cores, without the necessity of providing any other kind or character of forming rolls, or any other apparatus.

By using weights to draw the arms 97 continuously toward the core 104, and by placing the points of attachment to the arms 97 and the pulleys 102 at the places indicated, the action of the weights will be the same throughout the movement of the arms 97 toward the core 104. This arrangement is like fluid pressure and is far superior to the use of a spring, because the action of the latter becomes less and less as the arms advance toward one another.

The trimming of the fabric by the knives 151 has been described as a final operation of the machine, but it will be readily under-

stood that this trimming can be resorted to at any time in the construction of the tire if desired.

The method of operation when using the modified form shown in Figs. 14 and 15 is the same as that hereinabove described, except that the disk rolls 132 are not independently driven but are rotated by frictional engagement with the material on the rotating core 104.

After a tire has been built up by this machine as described, the core 104 carrying the tire, may be removed from the apparatus, either with or without the spider 105; after which the rubber tread may be placed thereon and the tire vulcanized or cured in any desired manner.

The forming rolls may be relatively small or large, but we have found that a diameter greater than the section of the core is desirable; and that it is particularly advantageous to rotate said rolls rapidly when the fabric, for any reason, fails to readily form about the sides of the core.

We have found that the mechanism described for stretching the fabric on the periphery of the core is so efficacious that the necessity for having a roll for forming the fabric on this part of the core is obviated. It will also be understood that the extent of the arcuate movement of the curved slide 122 in either direction may be fixed to suit particular conditions by varying the length of the slots 123 or the location of the pins 124 or 124*.

It will be understood that changes might be resorted to in the form, construction and arrangement of the several parts without departing from the spirit and scope of the invention; hence we do not wish to limit ourselves strictly to the structure herein set forth, but

What we claim is:—

1. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, means for rotating the core, and forming rolls power rotated by mechanism independent of the core rotating means for forming the material on the core.

2. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, means for rotating the core, and forming rolls power rotated by mechanism independent of the core rotating means for forming the material on the core, said rolls being greater in diameter than the core section.

3. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism adapted to pass radially across the core for forming the material thereon, automatic means for holding said mechanism laterally against the core, and means for varying said lateral pressure at will.

4. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism adapted to pass radially across the core for forming the material thereon, automatic means for holding said mechanism laterally against the core, means for varying said lateral pressure at will, and means for throwing said last-mentioned means into and out of operative position.

5. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, a pair of devices adapted to pass radially across the core for forming the material thereon, automatic means for holding said devices laterally against the core, and means for varying the lateral pressure of either device at will.

6. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, a pair of devices adapted to pass radially across the core for forming the material thereon, automatic means for holding said devices laterally against the core, means for varying the lateral pressure of either device at will, and means for throwing said last-mentioned means into and out of operative position with respect to either device.

7. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, automatic means for moving said mechanism radially across the core, and means for automatically stopping said radial movement at a predetermined point.

8. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, automatic means for moving said mechanism radially across the core, automatic means for pressing the said mechanism laterally against the core, and means for automatically stopping said radial movement at a predetermined point.

9. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, automatic means for moving said mechanism radially across the sides of the core, means for automatically stopping said radial movement at a predetermined point, and means for continuing said radial movement.

10. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the mate-

rial on the core, automatic means for moving said mechanism radially across the sides of the core, means for automatically stopping said radial movement at a predetermined point, and manually operated means for continuing said radial movement.

11. A machine of the character described comprising a rotary core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, automatic means for moving said mechanism radially across the core, and means for changing the rotary speed of the core and the radial speed of the forming mechanism.

12. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the core at an angle to the plane thereof, and means for varying the said angle of engagement.

13. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the core at an angle to the plane thereof, and means for varying the said angle of engagement at any point in the course of the radial movement.

14. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the material on the core at an angle to the said material, and means for maintaining the same angle of engagement throughout the forming operation.

15. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the material on the core at an angle to the said material, and means for varying the angular position of the forming elements, whereby they may engage differently lying portions of the material at substantially the same working angle.

16. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the material on the core at an angle to the said material, and means for maintaining a substantially right angular engagement throughout the forming operation.

17. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon and a single mechanism adapted to form the tire fabric on the core and over the bead cores.

18. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and mechanism for forming the fabric on the core both under and over the bead cores, said mechanism comprising a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the material at an angle thereto, and means for maintaining substantially the same angle of engagement throughout the radial movement.

19. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and mechanism for forming the fabric on the core, both under and over the bead cores, said mechanism comprising a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the material at an angle thereto, and means for automatically stopping said radial movement at the top of the bead cores.

20. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and mechanism for forming the fabric on the core both under and over the bead cores, said mechanism comprising a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the material at an angle thereto, means for automatically stopping said radial movement at the top of the bead cores, and means for containuing said radial movement to the base of the bead cores.

21. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and mechanism for forming the fabric on the core both under and over the bead cores, said mechanism comprising a device adapted to move ra-

dially with respect to the core, forming elements carried by said device and arranged to engage the material at an angle thereto, means for automatically stopping said radial movement at the top of the bead cores, and manually operated means for continuing said radial movement to the base of the bead cores.

22. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including forming elements adapted to move arcuately in planes at an angle to the plane of the core for maintaining a suitable angle of engagement with the material on the core throughout the forming operation.

23. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, a pair of arms pivoted thereon, supports on said arms carrying forming elements arranged to engage the material on the core, said supports being fitted to move arcuately for maintaining a suitable angle of engagement of the forming elements with the material throughout the forming operation.

24. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including forming elements fitted to move arcuately in planes at an angle to the plane of the core with the operating face of the forming elements as the center of the circle of the arc for maintaining a suitable angle of engagement with the material on the core throughout the forming operation.

25. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, a pair of arms pivoted thereon, supports on said arms carrying forming elements arranged to engage the material on the core, said supports being fitted to move arcuately with the operating face of the forming elements as the center of the circle of the arc for maintaining a suitable angle of engagement of the forming elements with the material throughout the forming operation.

26. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core including a device adapted to move radially with respect to the core, forming elements carried by the said device and arranged to move arcuately for maintaining a suitable angle of engagement throughout the forming operation, and means for pressing said forming elements laterally against the material on the core.

27. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, a pair of arms pivoted thereon, supports on said arms carrying forming elements arranged to engage the core, said supports being fitted to move arcuately for maintaining a suitable angle of engagement of the forming elements with the material on the core, and means for pressing the forming elements laterally against the material on the core.

28. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, forming elements carried thereby and adapted to engage the material on the core, said forming elements being arranged to move arcuately at any stage of the forming operation for maintaining a suitable angle of engagement with the material on the core.

29. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism being laterally pressed toward the core and adapted to move arcuately in a plane at an angle to the plane of the core for varying its relation with respect to the core.

30. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto and mechanism for forming the material on the core, said mechanism comprising a device adapted to move radially with respect to the core and forming elements laterally pressed toward the core, said forming elements being fitted to move arcuately for varying their relation to the core.

31. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including forming elements arranged to move radially with respect to the core and arcuately in planes at an angle to the plane of the core.

32. A machine of the character described

comprising a core upon which a tire may be built, means for supplying tire material thereto and mechanism for forming the material on the core, said mechanism including forming elements fitted to move radially with respect to the core and arcuately in planes at an angle to the plane of the core and pressed laterally toward the core with equal pressure at all times.

33. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, said mechanism including forming elements fitted to move radially with respect to the core and arcuately in a plane substantially at right angles to the plane of the core, said forming elements being laterally pressed toward the core, and means for resisting said lateral pressure.

34. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and power rotated rolls for forming the material on the sides of the core.

35. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and rolls of greater diameter than the core section for forming the material on the sides of the core.

36. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and power rotated rolls of greater diameter than the core section for forming the material on the sides of the core.

37. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, mechanism adapted to pass radially across the core for forming the material on the sides thereof, automatic means for holding said mechanism laterally against the core, and means for varying said lateral pressure at will.

38. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, mechanism adapted to pass radially across the core for forming the material on the sides thereof, automatic means for holding said mechanism laterally against the core, means for varying said lateral pressure at will, and means for throwing said last-mentioned means into and out of operative position.

39. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, a pair of devices adapted to pass radially across the core for forming the material on the sides thereof, automatic means for holding said devices laterally against the core, and means for varying the lateral pressure of either device at will.

40. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, a pair of devices adapted to pass radially across the core for forming the material on the sides thereof, automatic means for holding said devices laterally against the core, means for varying the lateral pressure of either device at will, and means for throwing said last-mentioned means into and out of operative position with respect to either device.

41. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, mechanism for forming the material on the sides of the core, automatic means for moving said mechanism radially across the core, and means for automatically stopping said radial movement at a predetermined point.

42. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, mechanism for forming the material on the sides of the core, automatic means for moving said mechanism radially across the core, automatic means for pressing the said mechanism laterally against the core, and means for automatically stopping said radial movement at a predetermined point.

43. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, mechanism for forming the material on the sides of the core, automatic means for moving said mechanism radially across the sides of the core, means for automatically stopping said radial movement at a predetermined point, and means for continuing said radial movement.

44. A machine of the character described comprising a rotary core upon which a tire may be built, means for stretching tire material onto the periphery of the core, mechanism for forming the material on the sides of the core, automatic means for moving said mechanism radially across the core, and means for changing the rotary speed of the core and the radial speed of the forming mechanism.

45. A machine of the character described comprising a core upon which a tire may be built, me ns for stretching tire material onto the periphery of the core, and mechanism for forming the material on the sides of the core, said mechanism including a device

adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the core at an angle to the plane thereof, and means for varying the said angle of engagement.

46. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and mechanism for forming the material on the sides of the core, said mechanism including a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the core at an angle to the plane thereof, and means for varying the said angle of engagement at any point in the course of the radial movement.

47. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and mechanism for forming the material on the sides of the core, said mechanism including a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the material on the core at an angle to the said material, and means for maintaining the same angle of engagement throughout the forming operation.

48. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and mechanism for forming the material on the sides of the core, said mechanism including a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the material on the core at an angle to the said material, and means for varying the angular position of the forming elements, whereby they may engage differently lying portions of the material at substantially the same working angle.

49. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and mechanism for forming the material on the sides of the core, said mechanism including a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the material on the core at an angle to the said material, and means for maintaining a substantially right angular engagement throughout the forming operation.

50. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, means for placing bead cores thereon, and a single mechanism adapted to form the tire fabric on the sides of the core and over the bead cores.

51. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, means for placing bead cores thereon, and mechanism for forming the fabric on the sides of the core both under and over the bead cores, said mechanism comprising a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the material at an angle thereto, and means for maintaining substantially the same angle of engagement throughout the radial movement.

52. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, means for placing bead cores thereon, and mechanism for forming the fabric on the sides of the core both under and over the bead cores, said mechanism comprising a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the material at an angle thereto, and means for automatically stopping said radial movement at the top of the bead cores.

53. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, means for placing bead cores thereon, and mechanism for forming the fabric on the sides of the core both under and over the bead cores, said mechanism comprising a device adapted to move radially with respect to the core, forming elements carried by said device and arranged to engage the material at an angle thereto, means for automatically stopping said radial movement at the top of the bead cores, and means for continuing said radial movement to the base of the bead cores.

54. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and mechanism for forming the material on the sides of the core, said mechanism including forming elements adapted to move arcuately in planes at an angle to the plane of the core for maintaining a suitable angle of engagement with the material on the core throughout the forming operation.

55. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and mechanism for forming the material on the sides of the core, said mechanism including a device adapted to move radially with respect to the core, a pair of arms pivoted thereon, supports on said arms carrying forming elements arranged to engage the material on

the core, said supports being fitted to move arcuately for maintaining a suitable angle of engagement of the forming elements with the material throughout the forming operation.

56. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and mechanism for forming the material on the sides of the core, said mechanism including forming elements fitted to move arcuately in planes at an angle to the plane of the core with the operating face of the forming elements as the center of the circle of the arc for maintaining a suitable angle of engagement with the material on the core throughout the forming operation.

57. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and mechanism for forming the material on the sides of the core, said mechanism including a device adapted to move radially with respect to the core, a pair of arms pivoted thereon, supports on said arms carrying forming elements arranged to engage the material on the core, said supports being fitted to move arcuately with the operating face of the forming elements as the center of the circle of the arc for maintaining a suitable angle of engagement of the forming elements with the material throughout the forming operation.

58. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, mechanism for forming the material on the sides of the core including a device adapted to move radially with respect to the core, forming elements carried by the said device and arranged to onto arcuately for maintaining a suitable adapted engagement throughout the form- forming the and means for pressing said automatic means laterally against the mechanism laterally agains for varying said latethe character described 38. A machine of on which a tire may be comprising a core upetching tire material built, means for stretof the core, mechanism the periphery of the crial on the sides of the ed to pass radially acn including a device ing the material on tally with respect to the matic means for hol pivoted thereon, sup- laterally against the carrying forming ele- said lateral pressure gage the core, said sup- throwing said last-mo move arcuately for out of operative posible angle of engage- 39. A machine of t elements with the ma- comprising a core upnd means for pressing built, means for strets laterally against the the periphery of the the character described

comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the ore, and mechanism for forming the material on the sides of the core, said mechanism including a device adapted to move radially with respect to the core, forming elements carried thereby and adapted to engage the material on the core, said forming elements being arranged to move arcuately at any stage of the forming operation for maintaining a suitable angle of engagement with the material on the core.

61. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and mechanism for forming the material on the sides of the core, said mechanism being laterally pressed toward the core and adapted to move arcuately in planes at an angle to the plane of the core for varying its relation with respect to the core.

62. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and mechanism for forming the material on the sides of the core, said mechanism comprising a device adapted to move radially with respect to the core and forming elements laterally pressed toward the core, said forming elements being fitted to move arcuately for varying their relation to the core.

63. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and mechanism for forming the material on the sides of the core, said mechanism including forming elements arranged to move radially with respect to the core and arcuately in planes at an angle to the plane of the core.

64. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, and mechanism for forming the material on the sides of the core, said mechanism including forming elements fitted to move radially and arcuately with respect to the core and pressed laterally toward the core with equal pressure at all times.

65. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, mechanism for forming the material on the sides of the core, said mechanism including forming elements adapted to move arcuately in planes at an angle to the plane of the core, said elements being laterally pressed toward the core, and means for resisting said lateral pressure.

66. A machine of the character described

comprising a core upon which a tire may be built, means for stretching tire material onto the periphery of the core, mechanism for forming the material on the sides of the core, said mechanism including forming elements fitted to move radially with respect to the core and arcuately in planes at an angle to the plane of the core, said forming elements being laterally pressed toward the core, and means for resisting said lateral pressure.

67. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, rolls adapted to pass radially across the core for forming the material thereon, automatic means for holding said rolls laterally against the core, and means for varying said lateral pressure at will.

68. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, rolls adapted to pass radially across the core for forming the material thereon, automatic means for holding said rolls laterally against the core, means for varying said lateral pressure at will, and means for throwing said last-mentioned means into and out of operative position.

69. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, a pair of rolls adapted to pass radially across the core for forming the material thereon, automatic means for holding said rolls laterally against the core, and means for varying the lateral pressure of either roll at will.

70. A machine of the character described comprising a core upon upon which a tire may be built, means for supplying tire material thereto, a pair of rolls adapted to pass radially across the core for forming the material thereon, automatic means for holding said rolls laterally against the core, means for varying the lateral pressure of either roll at will, and means for throwing said last-mentioned means into and out of operative position with respect to either roll.

71. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, rolls for forming the material on the core, automatic means for moving said rolls radially across the core, and means for automatically stopping said radial movement at a predetermined point.

72. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, rolls for forming the material on the core, automatic means for moving said rolls radially across the core, automatic means for pressing the said rolls laterally against the core, and means for automatically stopping said radial movement at a predetermined point.

73. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, rolls for forming the material on the core, automatic means for moving said rolls radially across the sides of the core, means for automatically stopping said radial movement at a predetermined point, and means for continuing said radial movement.

74. A machine of the character described comprising a rotary core upon which a tire may be built, means for supplying tire material thereto, rolls for forming the material on the core, automatic means for moving said rolls radially across the core, and means for changing the rotary speed of the core and the radial speed of the forming rolls.

75. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, forming rolls carried by said device and arranged to engage the core at an angle to the plane thereof, and means for varying the said angle of engagement.

76. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, forming rolls carried by said device and arranged to engage the core at an angle to the plane thereof, and means for varying the said angle of engagement at any point in the course of the radial movement.

77. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, forming rolls carried by said device and arranged to engage the material on the core at an angle to the said material, and means for maintaining the same angle of engagement throughout the forming operation.

78. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, forming rolls carried by said device and arranged to engage the material on the core at an angle to the said material, and means for varying the angu-

lar position of the forming rolls, whereby they may engage differently lying portions of the material at substantially the same working angle.

79. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, forming rolls carried by said device and arranged to engage the material on the core at an angle to the said material, and means for maintaining a substantially right angular engagement throughout the forming operation.

80. A machine of the character described comprising a côre upon which a tire may be built, means for placing tire fabric and bead cores thereon, and a roll adapted to form the tire fabric on the core and over the bead cores.

81. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and mechanism for forming the fabric on the core both under and over the bead cores, said mechanism including a device adapted to move radially with respect to the core, forming rolls carried by said device and arranged to engage the material at an angle thereto, and means for maintaining substantially the same angle of engagement throughout the radial movement.

82. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and mechanism for forming the fabric on the core, both under and over the bead cores, said mechanism including a device adapted to move radially with respect to the core, forming rolls carried by said device and arranged to engage the material at an angle thereto, and means for automatically stopping said radial movement at the top of the bead cores.

83. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and mechanism for forming the fabric on the core both under and over the bead cores, said mechanism including a device adapted to move radially with respect to the core, forming rolls carried by said device and arranged to engage the material at an angle thereto, means for automatically stopping said radial movement at the top of the bead cores, and means for continuing said radial movement to the base of the bead cores.

84. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including forming rolls adapted to move arcuately in planes at an angle to the plane of the core for maintaining a suitable angle of engagement with the material on the core throughout the forming operation.

85. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, a pair of arms pivoted thereon, supports on said arms carrying forming rolls arranged to engage the material on the core, said supports being fitted to move arcuately for maintaining a suitable angle of engagement of the forming rolls with the material throughout the forming operation.

86. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including forming rolls fitted to move arcuately with the operating face of the forming rolls as the center of the circle of the arc for maintaining a suitable angle of engagement with the material on the core throughout the forming operation.

87. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, a pair of arms pivoted thereon, supports on said arms carrying forming rolls arranged to engage the material on the core, said supports being fitted to move arcuately with the operating face of the forming rolls as the center of the circle of the arc for maintaining a suitable angle of engagement of the forming rolls with the material throughout the forming operation.

88. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core including a device adapted to move radially with respect to the core, forming rolls carried by the said device and arranged to move arcuately for maintaining a suitable angle of engagement throughout the forming operation, and means for pressing said forming rolls laterally against the material on the core.

89. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, said mechanism including a de-

vice adapted to move radially with respect to the core, a pair of arms pivoted thereon, supports on said arms carrying forming rolls arranged to engage the core, said supports being fitted to move arcuately for maintaining a suitable angle of engagement of the forming rolls with the material on the core, and means for pressing the forming rolls laterally against the material on the core.

90. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, forming rolls carried thereby, and adapted to engage the material on the core, said forming rolls being arranged to move arcuately at any stage of the forming operation for maintaining a suitable angle of engagement with the material on the core.

91. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and rolls for forming the material on the core, said rolls being laterally pressed toward the core and adapted to move arcuately in planes at an angle to the plane of the core for varying their relation with respect to the core.

92. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core and forming rolls laterally pressed toward the core, said forming rolls being fitted to move arcuately for varying their relation to the core.

93. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including forming rolls arranged to move radially with respect to the core and arcuately in planes at an angle to the plane of the core.

94. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto and mechanism for formi..g the material on the core, said mechanism including forming rolls fitted to move radially and arcuately with respect to the core and pressed laterally toward the core with equal pressure at all times.

95. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, said mechanism including forming rolls adapted to move arcuately in planes at an angle to the plane of the core, said rolls being laterally pressed toward the core, and means for resisting said lateral pressure.

96. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, said mechanism including forming rolls fitted to move radially with respect to the core and arcuately in planes at an angle to the plane of the core, said forming rolls being laterally pressed toward the core, and means for resisting said lateral pressure.

97. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, power driven rolls adapted to pass radially across the core for forming the material thereon, and means for holding said power driven rolls laterally against the core with equal pressure throughout their movement.

98. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, power driven rolls adapted to pass radially across the core for forming the material thereon, and a weight so arranged as to hold said power driven rolls laterally against the core with equal pressure throughout its movement.

99. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, power driven swinging rolls adapted to pass radially across the core for forming the material thereon, and means for holding said power driven rolls laterally against the core with equal pressure throughout its movement, said means comprising a weight, a fixed pulley and a cord secured to the weight and forming rolls and passing over the said pulley, both the pulley and the point of attachment of the cord to the forming rolls being substantially equidistant from the fulcrum point of the forming rolls.

100. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, power driven rolls adapted to pass radially across the core for forming the material thereon, automatic means for holding said power driven rolls laterally against the core, and means for varying said lateral pressure at will.

101. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, power driven rolls adapted to pass

radially across the core for forming the material thereon, automatic means for holding said power driven rolls laterally against the core, means for varying said lateral pressure at will, and means for throwing said last-mentioned means into and out of operative position.

102. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, a pair of power driven rolls adapted to pass radially across the core for forming the material thereon, automatic means for holding said power driven rolls laterally against the core, and means for varying the lateral pressure of either roll at will.

103. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, a pair of power driven rolls adapted to pass radially across the core for forming the material thereon, automatic means for holding said power driven rolls laterally against the core, means for varying the lateral pressure on either roll at will, and means for throwing said last-mentioned means into and out of operative position with respect to either power driven roll.

104. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, power driven rolls for forming the material on the core, and automatic means for moving said power driven rolls radially across the core.

105. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, power driven rolls for forming the material on the core, automatic means for moving said power driven rolls radially across the core, and means for automatically stopping said radial movement at a predetermined point.

106. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, power driven rolls for forming the material on the core, automatic means for moving said power driven rolls radially across the core, and automatic means for pressing the said power driven rolls laterally against the core.

107. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, power driven rolls for forming the material on the core, automatic means for moving said power driven rolls radially across the core, automatic means for pressing the said power driven rolls laterally against the core, and means for automatically stopping said radial movement at a predetermined point.

108. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, power driven rolls for forming the material on the core, automatic means for moving said power driven rolls radially across the sides of the core, means for automatically stopping said radial movement at a predetermined point, and means for continuing said radial movement.

109. A machine of the character described comprising a rotary core upon which a tire may be built, means for supplying tire material thereto, power driven rolls for forming the material on the core, automatic means for moving said power driven rolls radially across the core, and means for changing the rotary speed of the core and the radial speed of the rolls.

110. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, power driven rolls carried by said device and arranged to engage the core at an angle to the plane thereof, and means for varying the said angle of engagement.

111. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, power driven rolls carried by said device and arranged to engage the core at an angle to the plane thereof, and means for varying the said angle of engagement at any point in the course of the radial movement.

112. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, power driven rolls carried by said device and arranged to engage the material on the core at an angle to the said material, and means for maintaining the same angle of engagement throughout the forming operation.

113. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, power driven rolls carried by said device and arranged to engage the material on the core at an angle to the said material, and means for varying the angu-

lar position of the rolls, whereby they may engage differently lying portions of the material at substantially the same working angle.

114. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, power driven rolls carried by said device and arranged to engage the material on the core at an angle to the said material, and means for maintaining a substantially right angular engagement throughout the forming operation.

115. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and a power driven roll adapted to form the tire fabric on the core both under and over the bead cores.

116. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and mechanism for forming the fabric on the core both under and over the bead cores, said mechanism including a device adapted to move radially with respect to the core, power driven rolls carried by said device and arranged to engage the material at an angle thereto, and means for maintaining substantially the same angle of engagement throughout the radial movement.

117. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and mechanism for forming the fabric on the core both under and over the bead cores, said mechanism including a device adapted to move radially with respect to the core, power driven rolls carried by said devise and arranged to engage the material at an angle thereto, and means for automatically stopping said radial movement at the top of the bead cores.

118. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and mechanism for forming the fabric on the core both under and over the bead cores, said mechanism including a device adapted to move radially with respect to the core, power driven rolls carried by said device and arranged to engage the material at an angle thereto, means for automatically stopping said radial movement at the top of the bead cores, and means for continuing said radial movement to the base of the bead cores.

119. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including power driven rolls adapted to move arcuately for maintaining a suitable angle of engagement with the material on the core throughout the forming operation.

120. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, a pair of arms pivoted thereon, supports on said arms carrying power driven rolls arranged to engage the material on the core, said supports being fitted to move arcuately for maintaining a suitable angle of engagement of the power driven rolls with the material throughout the forming operation.

121. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including power driven rolls fitted to move arcuately with the operating face of the power driven rolls as the center of the circle of the arc for maintaining a suitable angle of engagement with the material on the core throughout the forming operation.

122. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, a pair of arms pivoted thereon, supports on said arms carrying power driven rolls arranged to engage the material on the core, said supports being fitted to move arcuately with the operating face of the power driven rolls as the center of the circle of the arc for maintaining a suitable angle of engagement of the power driven rolls with the material throughout the forming operation.

123. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core including a device adapted to move radially with respect to the core, power driven rolls carried by the said device and arranged to move arcuately for maintaining a suitable angle of engagement throughout the forming operation, and means for pressing said power driven rolls laterally against the material on the core.

124. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, said mechanism including a

device adapted to move radially with respect to the core, a pair of arms pivoted thereon, supports on said arms carrying power driven rolls arranged to engage the core, said supports being fitted to move arcuately for maintaining a suitable angle of engagement of the power driven rolls with the material on the core, and means for pressing the power driven rolls laterally against the material on the core.

125. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core, power driven forming rolls carried thereby and adapted to engage the material on the core, said power driven forming rolls being arranged to move arcuately at any stage of the forming operation for maintaining a suitable angle of engagement with the material on the core.

126. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and power driven rolls for forming the material on the core, said power driven rolls being laterally pressed toward the core and adapted to move arcuately for varying their relation with respect to the core.

127. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including a device adapted to move radially with respect to the core and power driven forming rolls laterally pressed toward the core, said power driven-forming rolls being fitted to move arcuately for varying their relation to the core.

128. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, and mechanism for forming the material on the core, said mechanism including power driven forming rolls arranged to move radially and arcuately with respect to the core.

129. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto and mechanism for forming the material on the core, said mechanism including power driven forming rolls fitted to move radially and arcuately with respect to the core and pressed laterally toward the core.

130. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, said mechanism including power driven forming rolls laterally pressed toward the core, and means for resisting said lateral pressure.

131. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, said mechanism including power driven forming rolls arranged to move radially with respect to the core, the said power driven forming rolls being laterally pressed toward the core, and means for resisting said lateral pressure.

132. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, said mechanism including power driven forming rolls adapted to move arcuately with respect to the core, said power driven forming rolls being laterally pressed toward the core, and means for resisting said lateral pressure.

133. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, mechanism for forming the material on the core, said mechanism including power driven forming rolls fitted to move radially and arcuately with respect to the core, said power driven forming rolls being laterally pressed toward the core, and means for resisting said lateral pressure.

134. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, means for rotating said core, rotatable mechanism for forming the material on the core, and means for driving said forming mechanism at a greater surface speed than the core.

135. A machine of the character described comprising a core upon which a tire may be built, means for supplying tire material thereto, means for rotating said core, rolls for forming the material on the core, and means for driving said rolls at a greater surface speed than the core.

136. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and a single mechanism adapted to move radially with respect to the core and arcuately in a plane substantially at right angles to the plane of the core for forming the tire fabric on the core both under and over the bead cores.

137. A machine of the character described comprising a core upon which a tire may be built, means for stretching tire fabric on to the periphery of the core, means for placing bead cores on said core, and a single mechanism adapted to move radially with respect to the core and arcuately in a plane substantially at right angles to the plane of the core for forming the tire fabric on the

sides of the core both under and over the bead cores.

138. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and a roll adapted to move radially with respect to the core and arcuately in a plane substantially at right angles to the core for forming the tire fabric on the core both under and over the bead cores.

139. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and a pair of rolls adapted to move radially with respect to the core and arcuately in a plane substantially at right angles to the plane of the core for forming the fabric on both sides of the core, both under and over the bead cores.

140. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and a power driven roll adapted to move radially and arcuately with respect to the core for forming the tire fabric on the core both under and over the bead cores.

141. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and a pair of power driven rolls adapted to move radially and arcuately with respect to the core for forming the tire on the core both under and over the bead cores.

142. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and a device arranged to engage differently lying portions of the material at substantially the same working angle for forming the fabric on the core both under and over the bead cores.

143. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon and a pair of devices arranged to engage differently lying portions of the material at substantially the same working angle for forming the fabric on the core both under and over the bead cores.

144. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and a single mechanism for forming the tire fabric on the core both under and over the bead cores, said mechanism comprising a pivoted arm mounted to move radially with respect to the core, that portion of the arm nearer the core being of curved formation, a bracket arm fitted to slide on the curved portion of said arm, and a forming element carried by the bracket arm and adapted to be moved laterally toward and away from the core by swinging the first-mentioned arm on its pivot.

145. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, and a single mechanism for forming the tire fabric on the core both under and over the bead cores, said mechanism comprising a pair of pivoted arms mounted to move radially with respect to the core, that portion of the arms nearer the core being of curved formation, bracket arms fitted to slide on the curved portions of said arms, and forming elements carried by the bracket arms and adapted to be moved laterally toward and away from the core by swinging the first-mentioned arms on their pivots.

146. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, a single mechanism for forming the tire fabric on the core both under and over the bead cores, said mechanism comprising a pair of pivoted arms mounted to move radially with respect to the core, that portion of the arms nearer the core being of curved formation, bracket arms fitted to slide on the curved portions of said arms, forming elements carried by the bracket arms and adapted to be moved laterally toward and away from the core by swinging the first-mentioned arms on their pivots, and means for positively swinging either of said arms on its pivot.

147. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, a single mechanism for forming the tire fabric on the core both under and over the bead cores, said mechanism comprising a pair of pivoted arms mounted to move radially with respect to the core, that portion of the arms nearer the core being of curved formation, bracket arms fitted to slide on the curved portions of said arms, forming elements carried by the bracket arms and adapted to be moved laterally toward and away from the core by swinging the first-mentioned arms on their pivots, and means for positively and simultaneously swinging both said arms on their pivots.

148. A machine of the character described comprising a core upon which a tire may be built, means for placing tire fabric and bead cores thereon, a single mechanism for forming the tire fabric on the core both under and over the bead cores, said mechanism comprising a pair of pivoted arms mounted to move radially with respect to the core, that portion of the arms nearer the core being of curved formation, bracket arms fitted to slide on the curved portions of said arms, forming elements carried by the

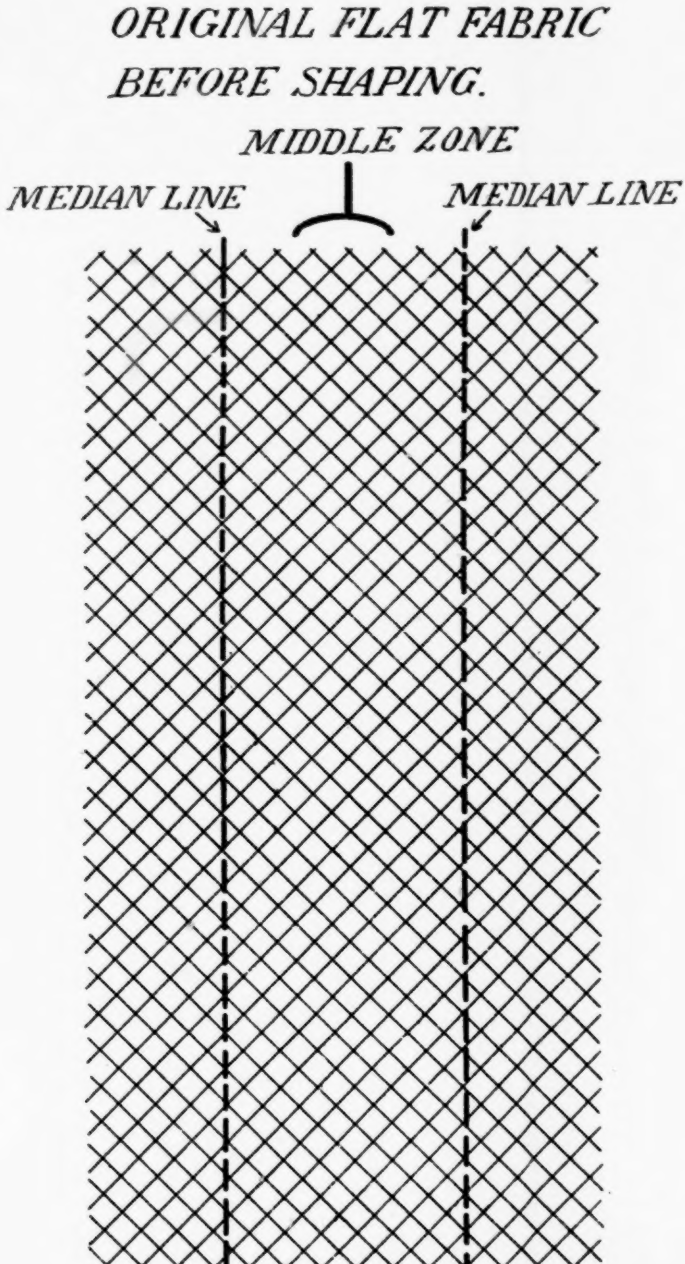
bracket arms, and adapted to be moved laterally toward and away from the core by swinging the first-mentioned arms on their pivots, and means for positively and simultaneously swinging both said arms in opposite directions on their pivots.

In testimony, that we claim the foregoing as our invention, we have signed our names in presence of two witnesses, this twenty-second day of January 1912.

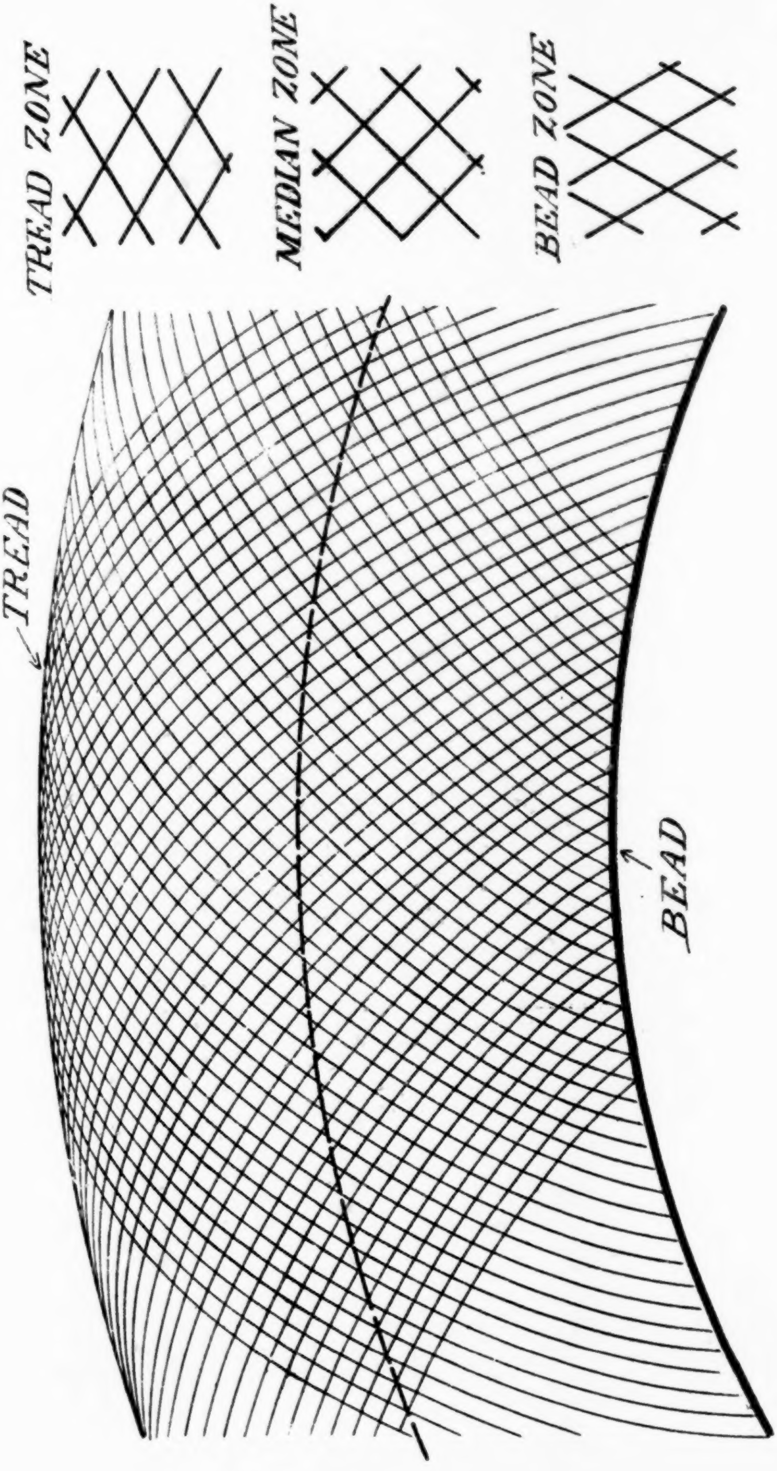
JOHN E. THROPP.
PETER D. THROPP.
ALBERT DE LASKI.

Witnesses:
F. GEORGE BARRY,
HENRY C. THIEME.

Plaintiff's Exhibit No. 4.

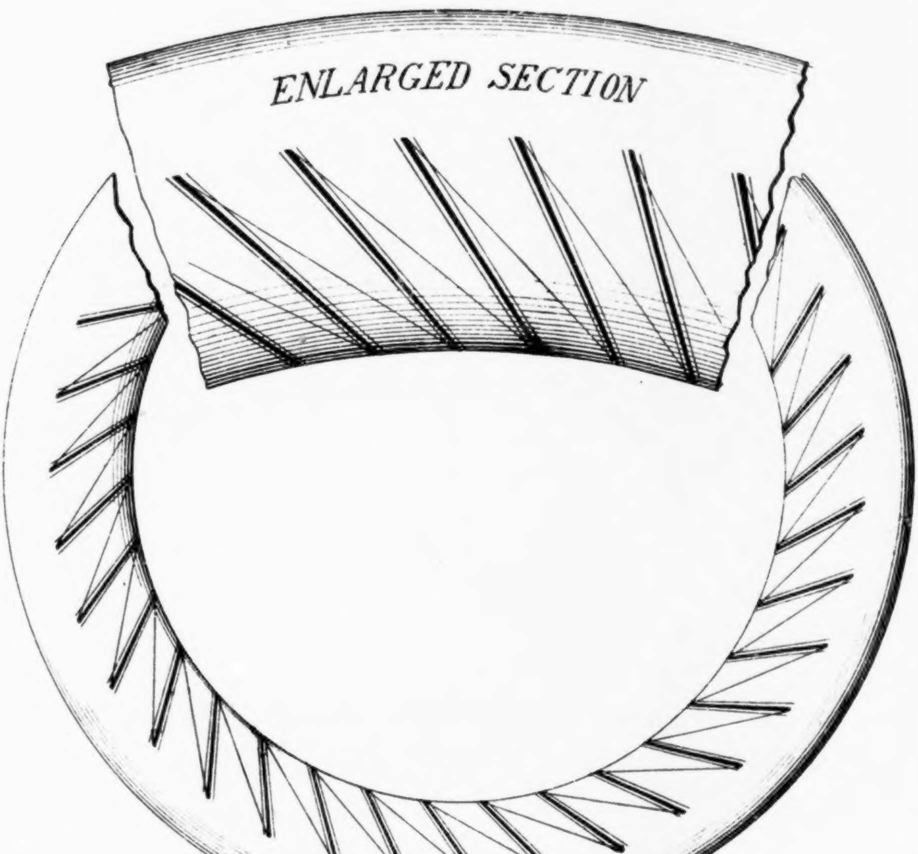


Plaintiff's Exhibit No. 5—Fabric Shaped to Core.

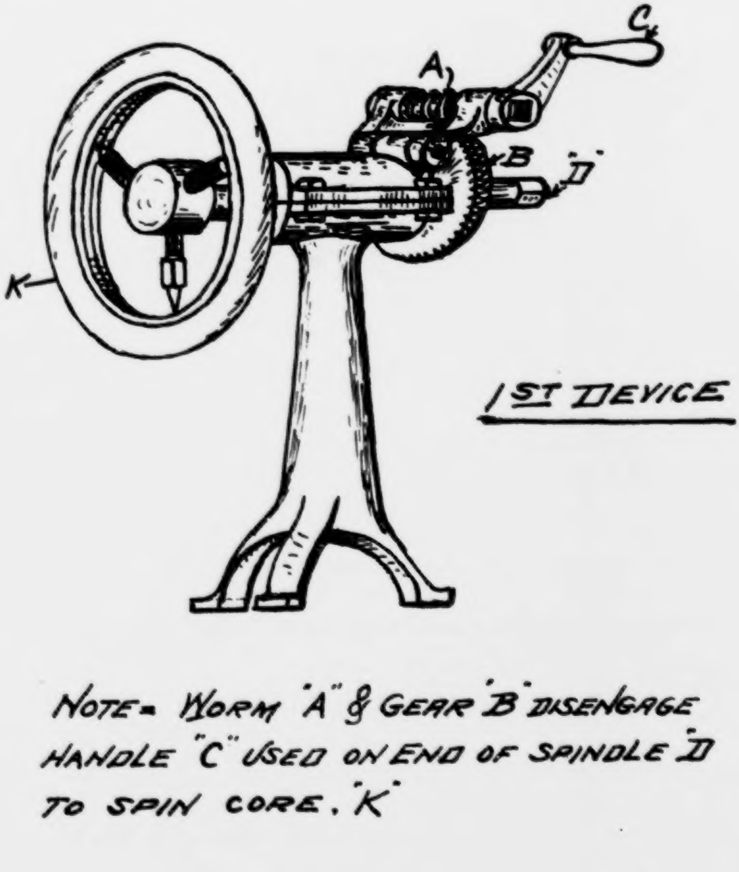


Plaintiff's Exhibit No. 7.

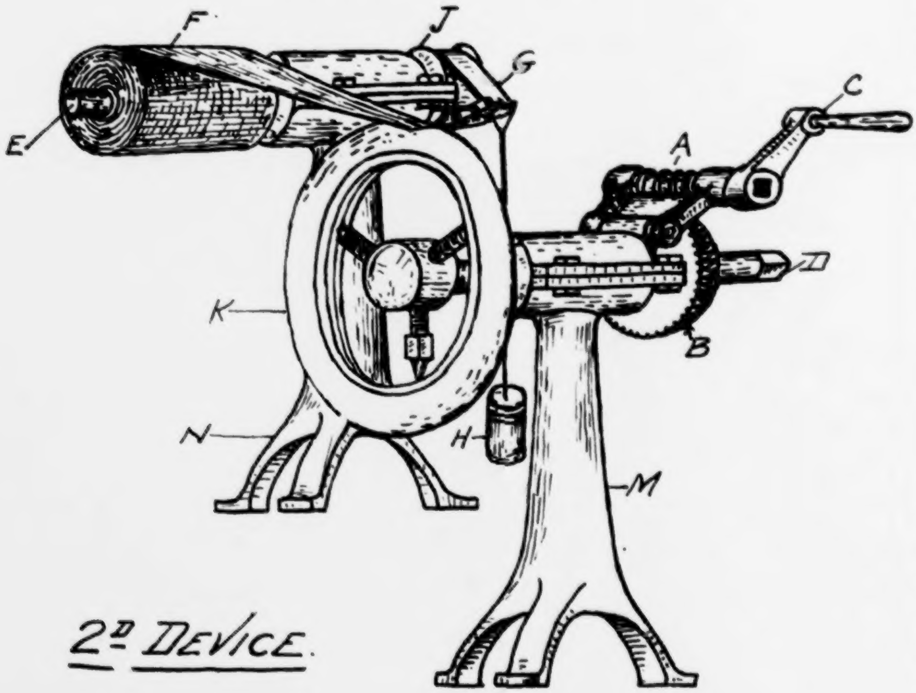
SAW TOOTH PATH OF HAND TOOL



Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (1st Device.)



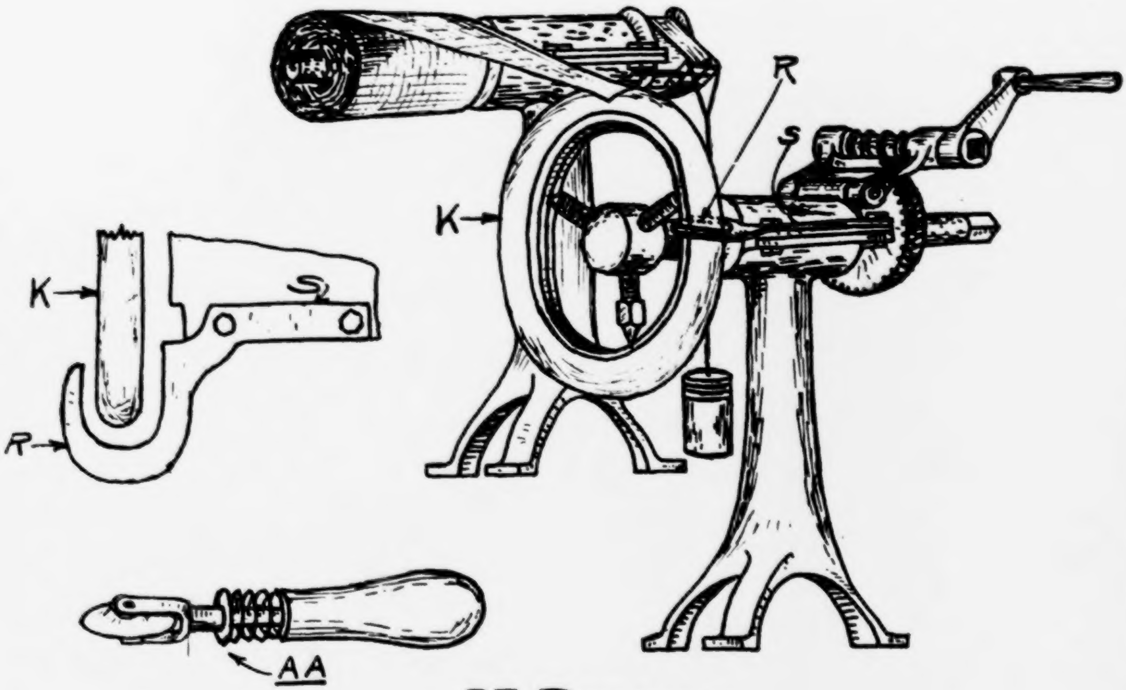
Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (2nd Device.)



2D DEVICE.

NOTE= WORM "A" & GEAR "B" DISENGAGED AFTER PLY "F" IS PULLED ON CORE "K". HANDLE "C" TRANSFERRED TO SPINDLE "D" TO SPIN CORE "K". STOCK ROLL STAND "N" FITTED WITH BRAKE "J&G" WEIGHTED AS SHOWN "H" STOCK ROLL SLEEVE KEYED TO SPINDLE "E" OPERATING WITH "J&G". ROLLS OF STOCK "F" CHANGED FOR EACH PLY. OR AS OFTEN AS REQUIRED.

Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (3rd Device.)

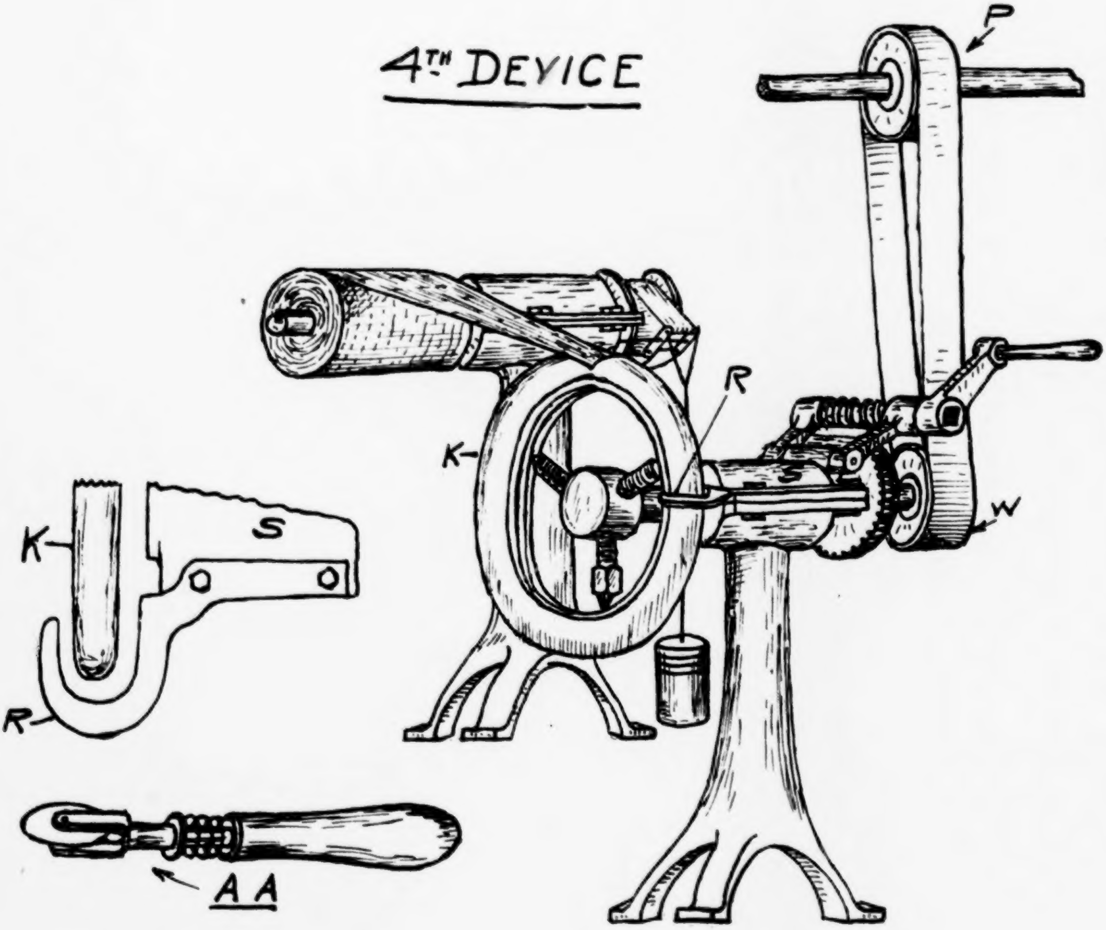


3D DEVICE

OPERATION OF THIS DEVICE IS THE SAME AS ON 2D DEVICE, IN ADDITION THERE IS ATTACHED A TOOL SUPPORT "R" IN BRACKET FORM SECURED BY BOLTS ON HOUSING "S" ATTACHMENT USED FOR MANIPULATING VARIOUS TOOLS BY HAND SUCH AS STITCHER "AA" ETC.

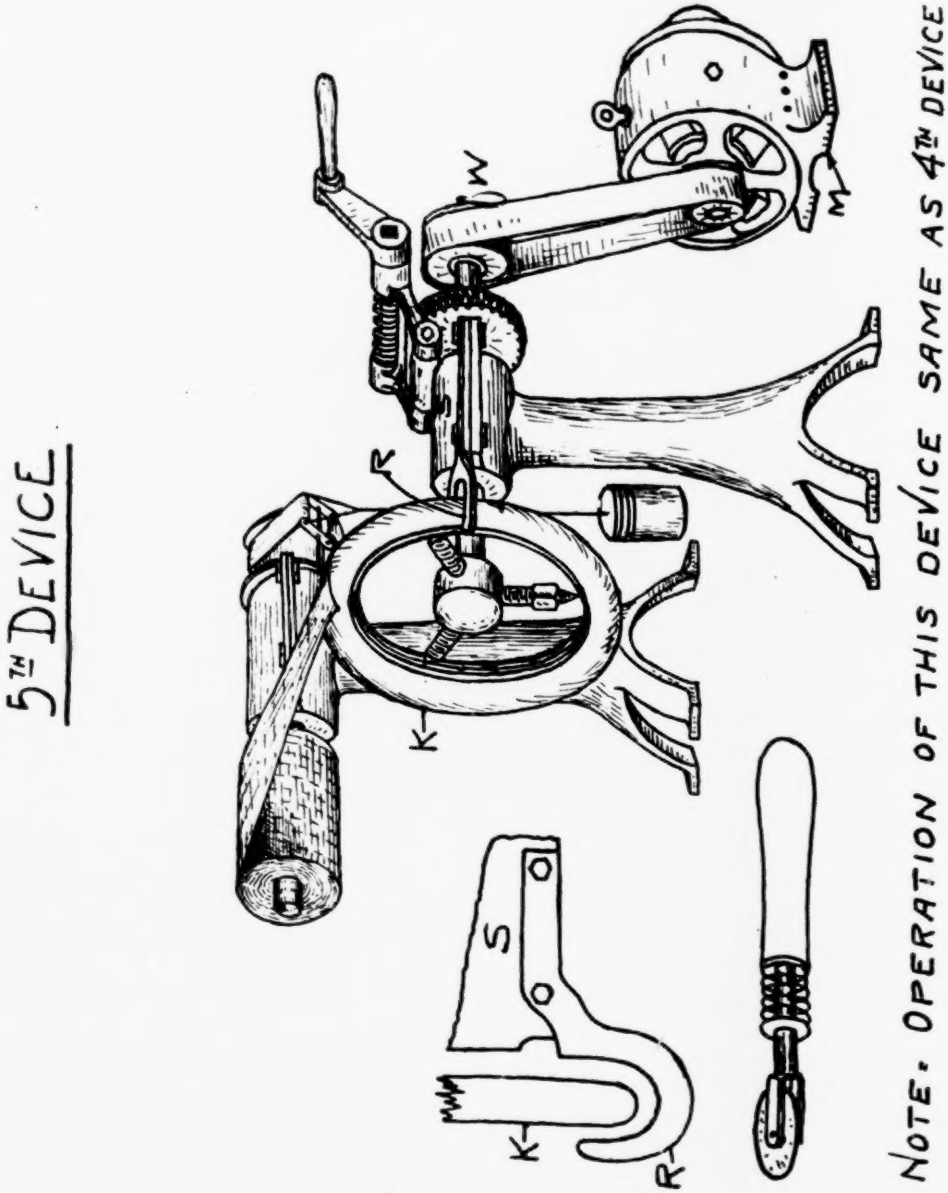
Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (4th Device.)

4TH DEVICE



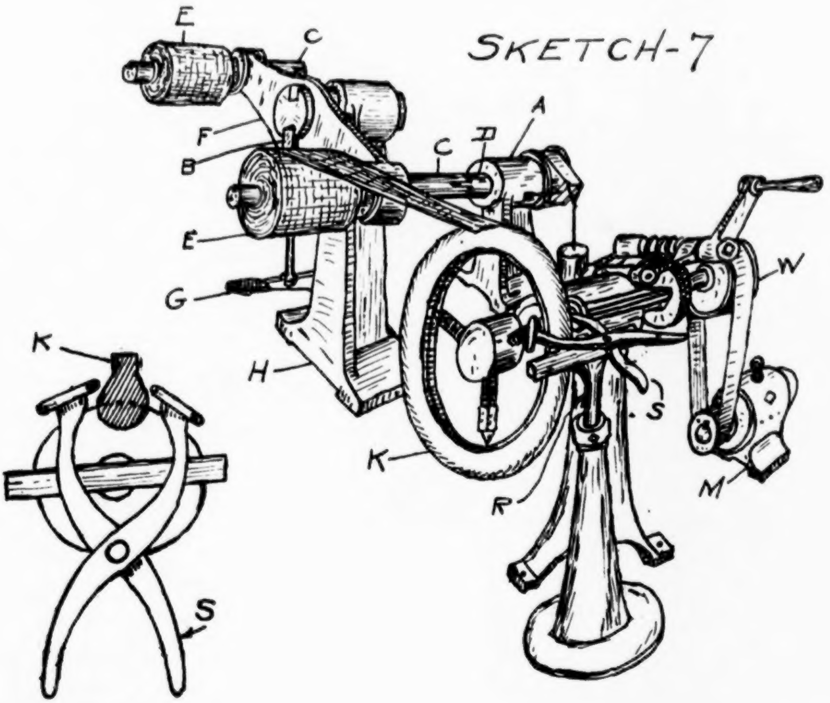
OPERATION OF THIS DEVICE SAME AS 3D DEVICE
WITH THE ADDITION OF POWER DRIVE "P&W,"
PULLEYS SELECTED TO SUIT R.P.M OF "K"

Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (5th Device.)



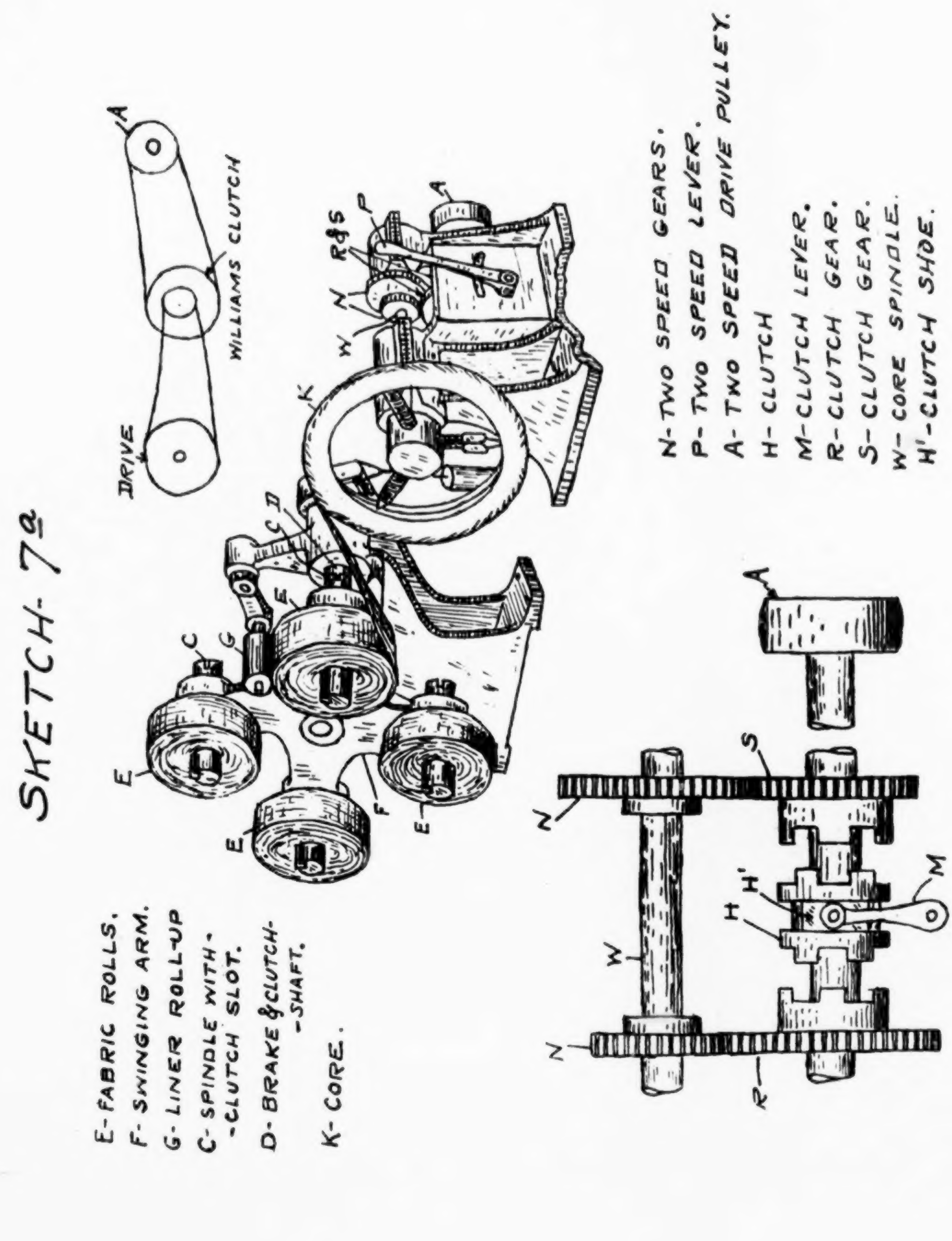
Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (Sketch 7.)

A- CLUTCH & BRAKE SUPPORT.
B- SWINGING ARM LOCK.
C- SPINDLE WITH CLUTCH SLOT.
D- BRAKE & CLUTCH SHAFT.
E- FABRIC ROLLS.
F- SWINGING ARM.
G- LOCK LATCH PEDAL.
H- ARM SUPPORT.

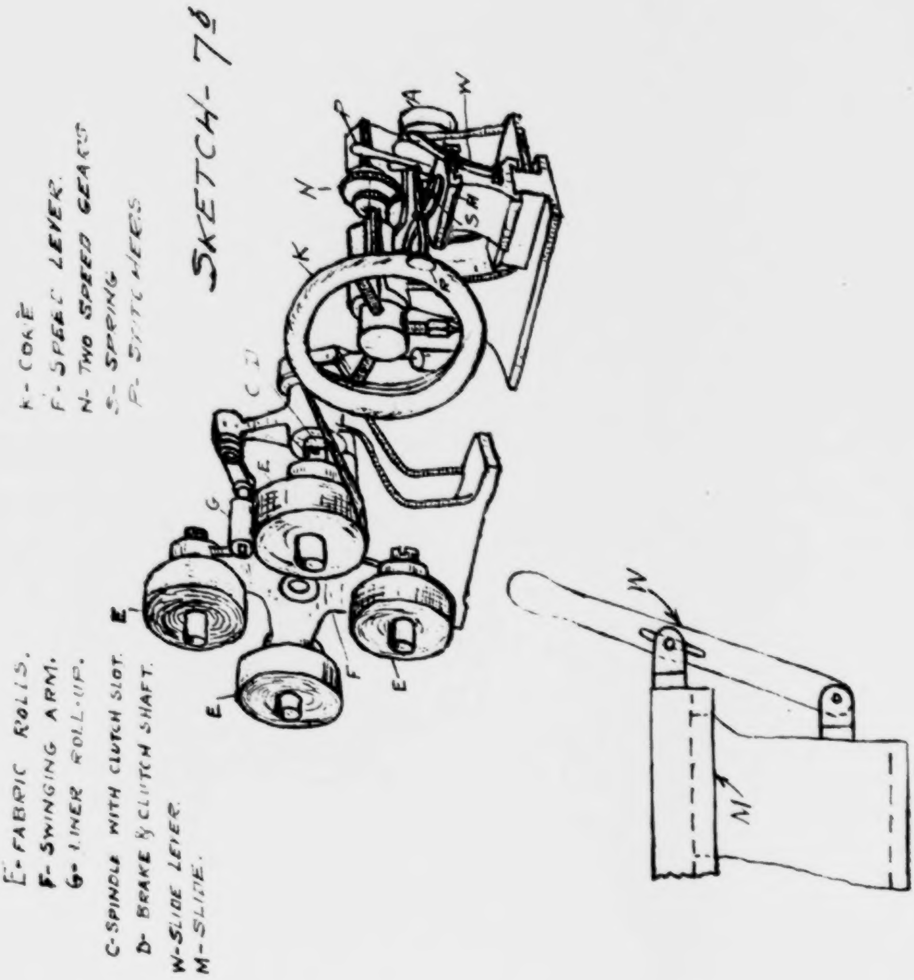


K- CORE.
R- STITCHER SUPPORT
S- STITCHER DEVICE.

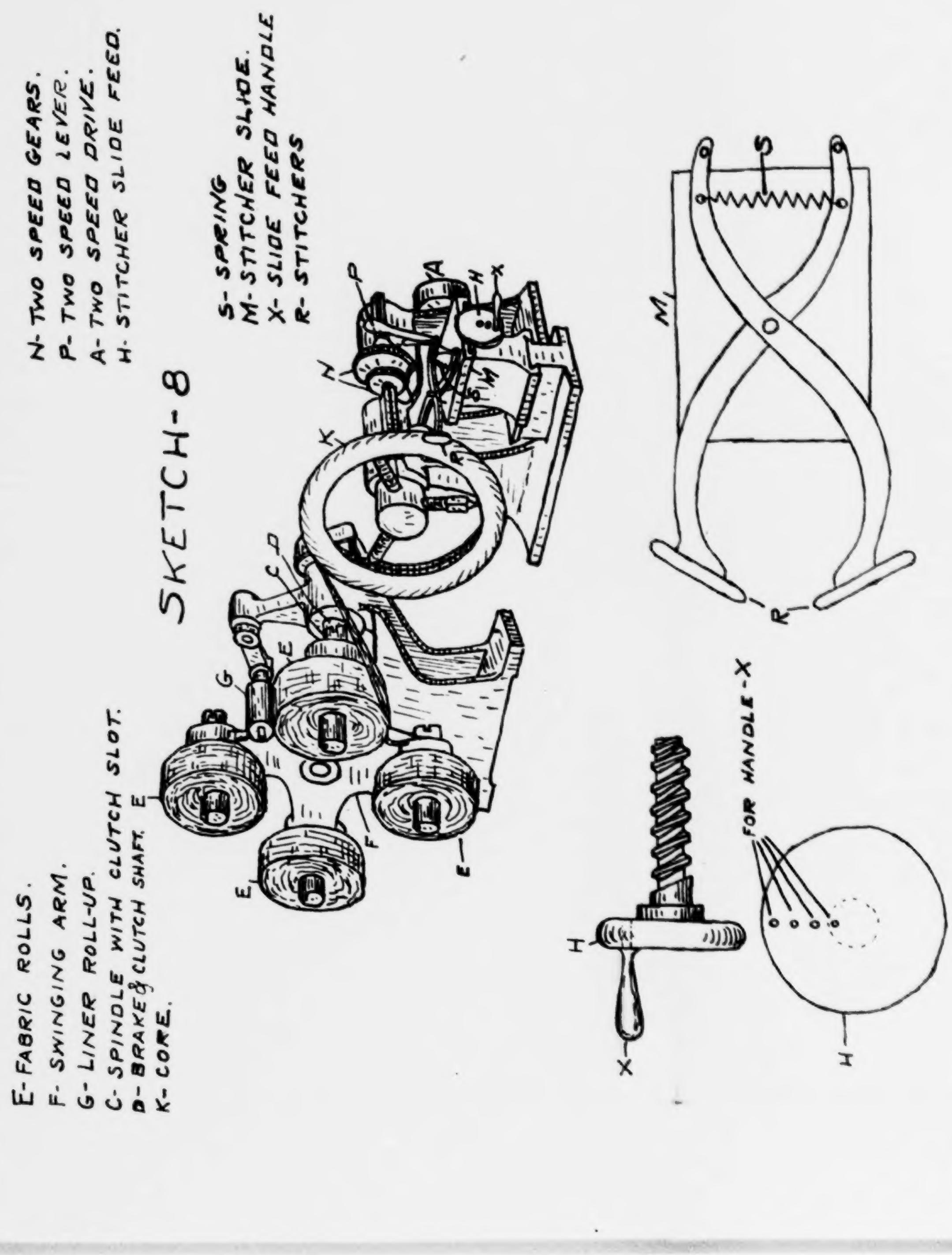
Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (Sketch 7a.)



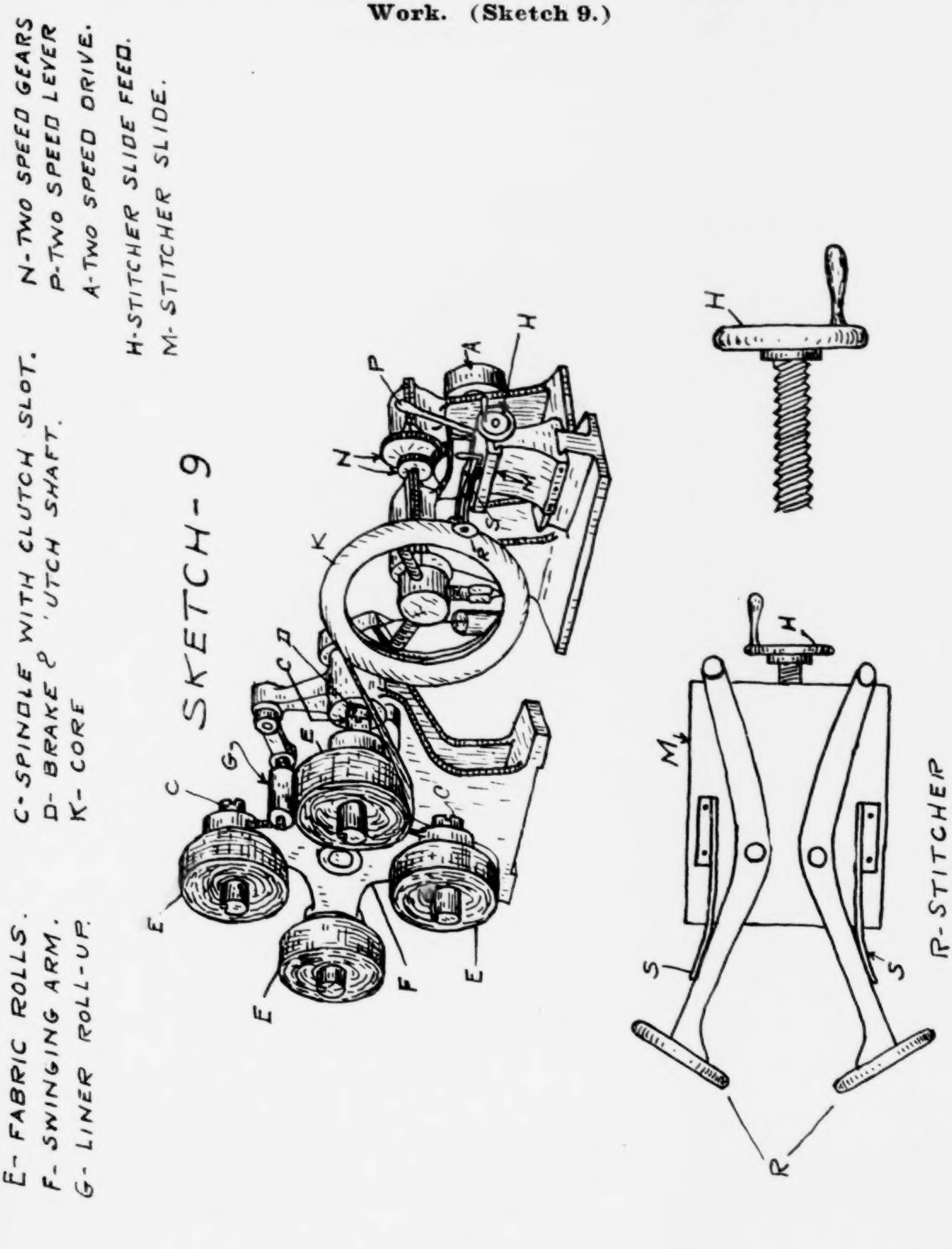
Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (Sketch 7b.)



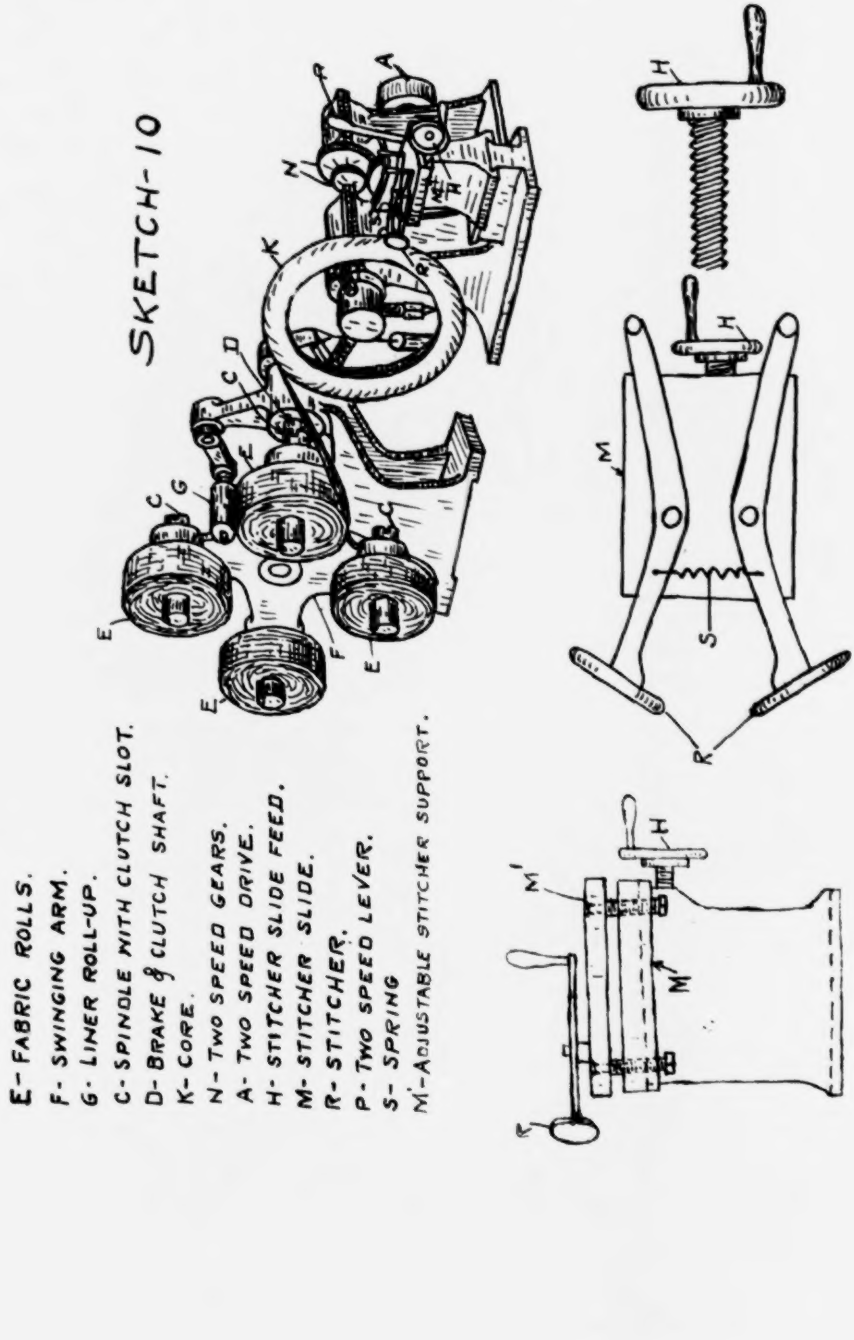
Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (Sketch 8.)



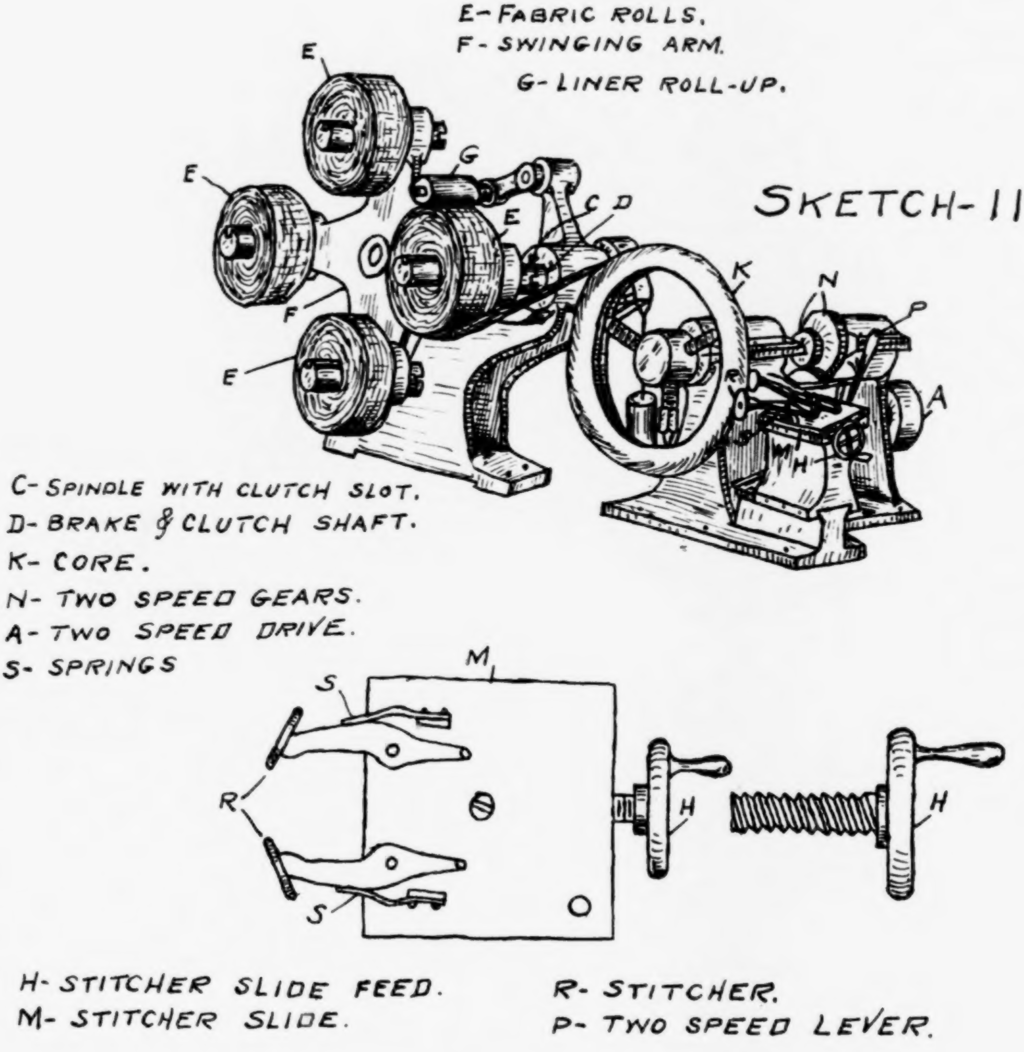
Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (Sketch 9.)



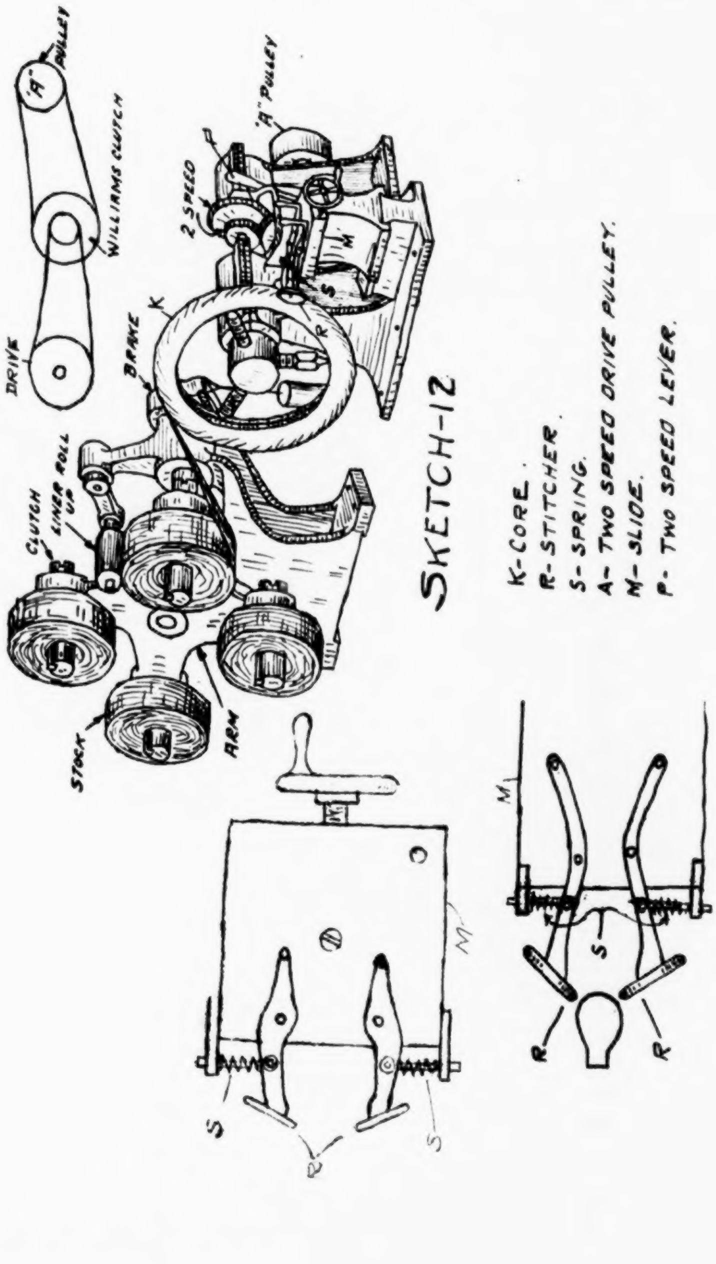
Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (Sketch 10.)



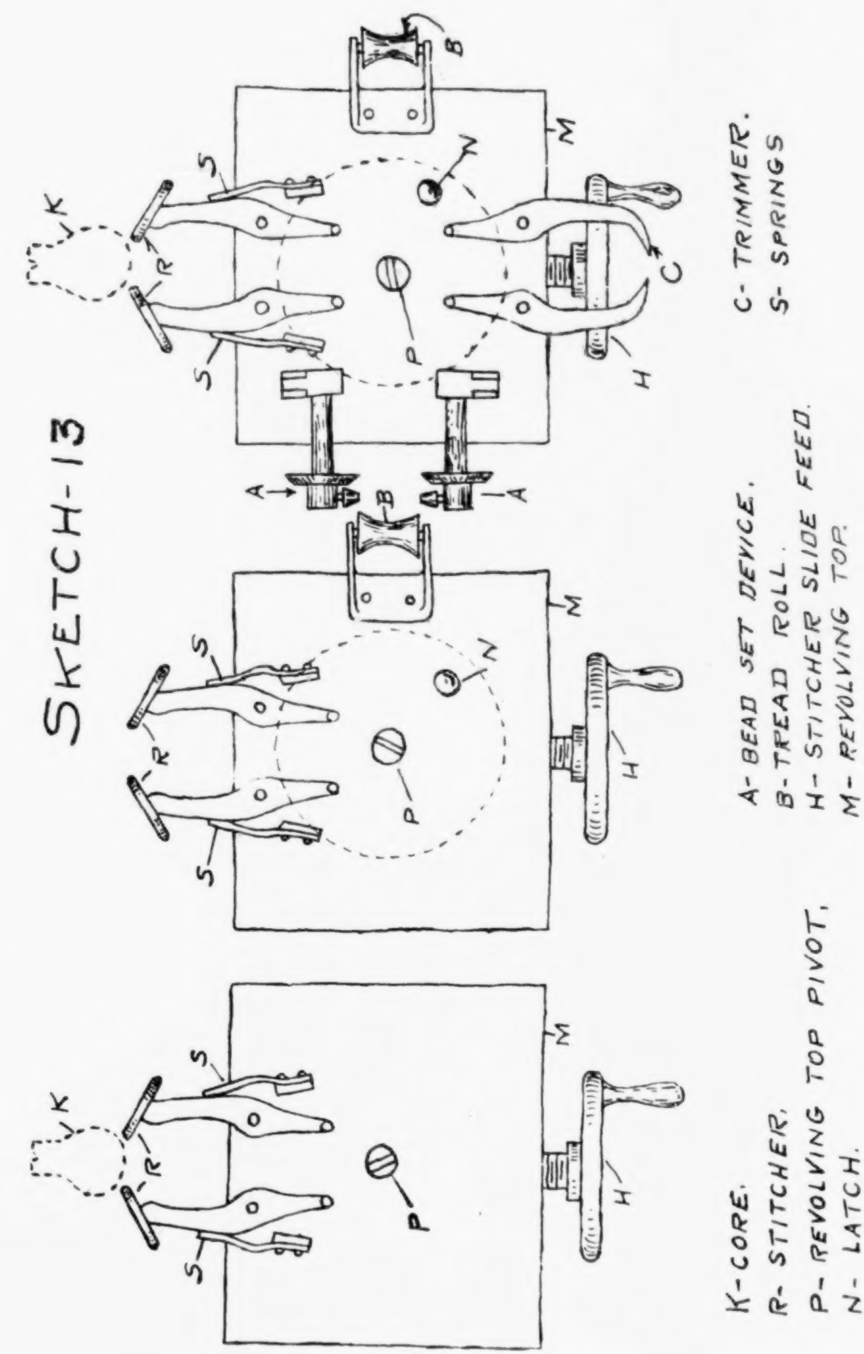
Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (Sketch 11.)



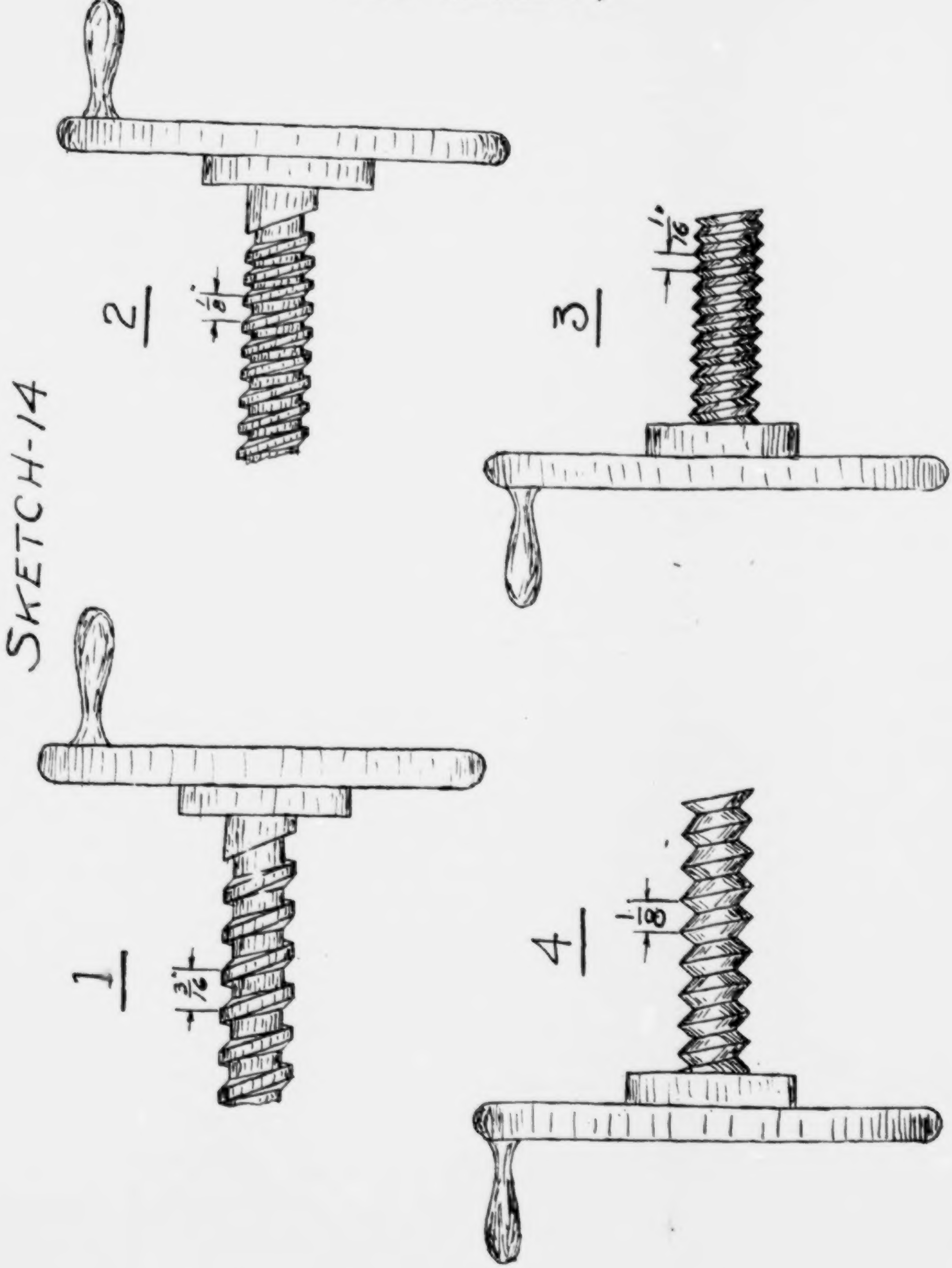
Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (Sketch 12.)



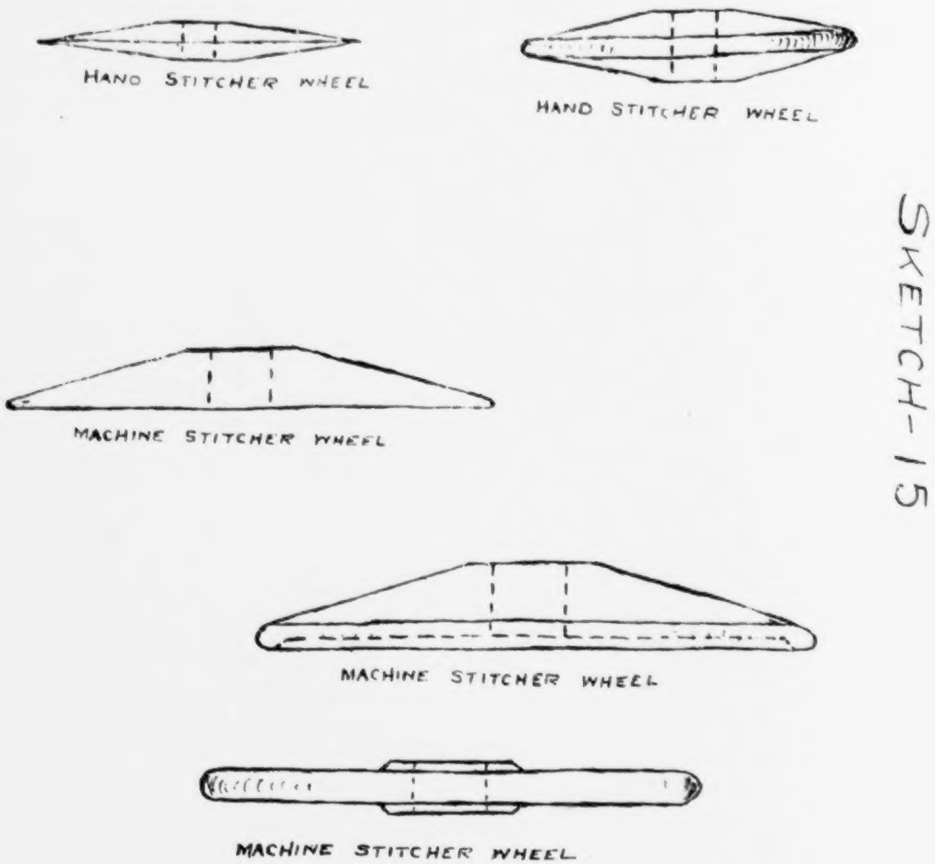
Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (Sketch 13.)



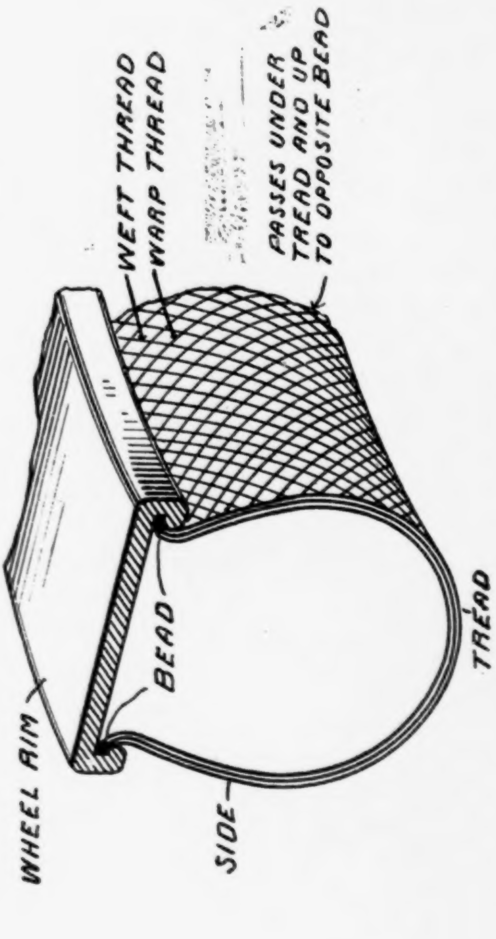
Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (Sketch 14.)



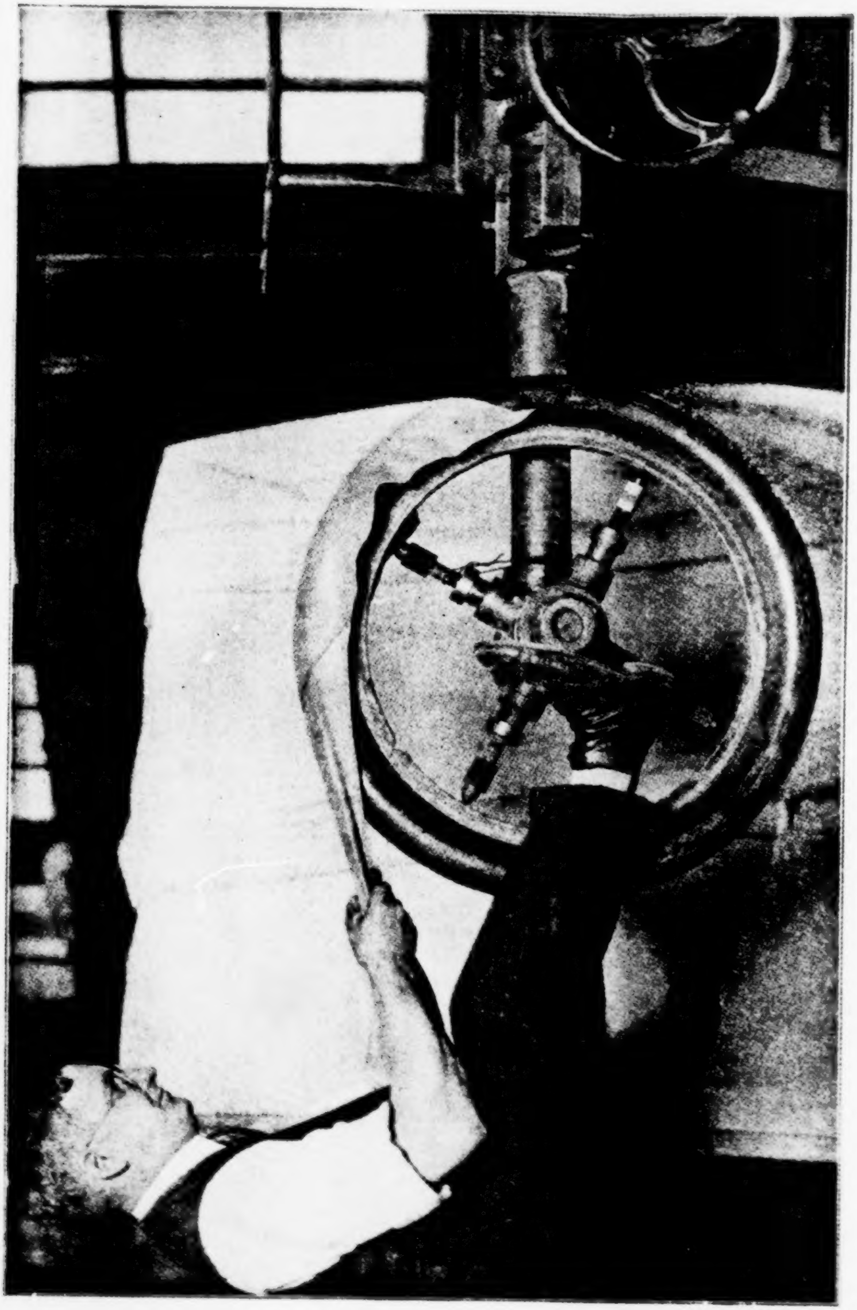
Plaintiff's Exhibit No. 8—Sketches of Experimental Work. (Sketch 15.)



Plaintiff's Exhibit No. 10—Diagram of Carcass and Wheel Rim.

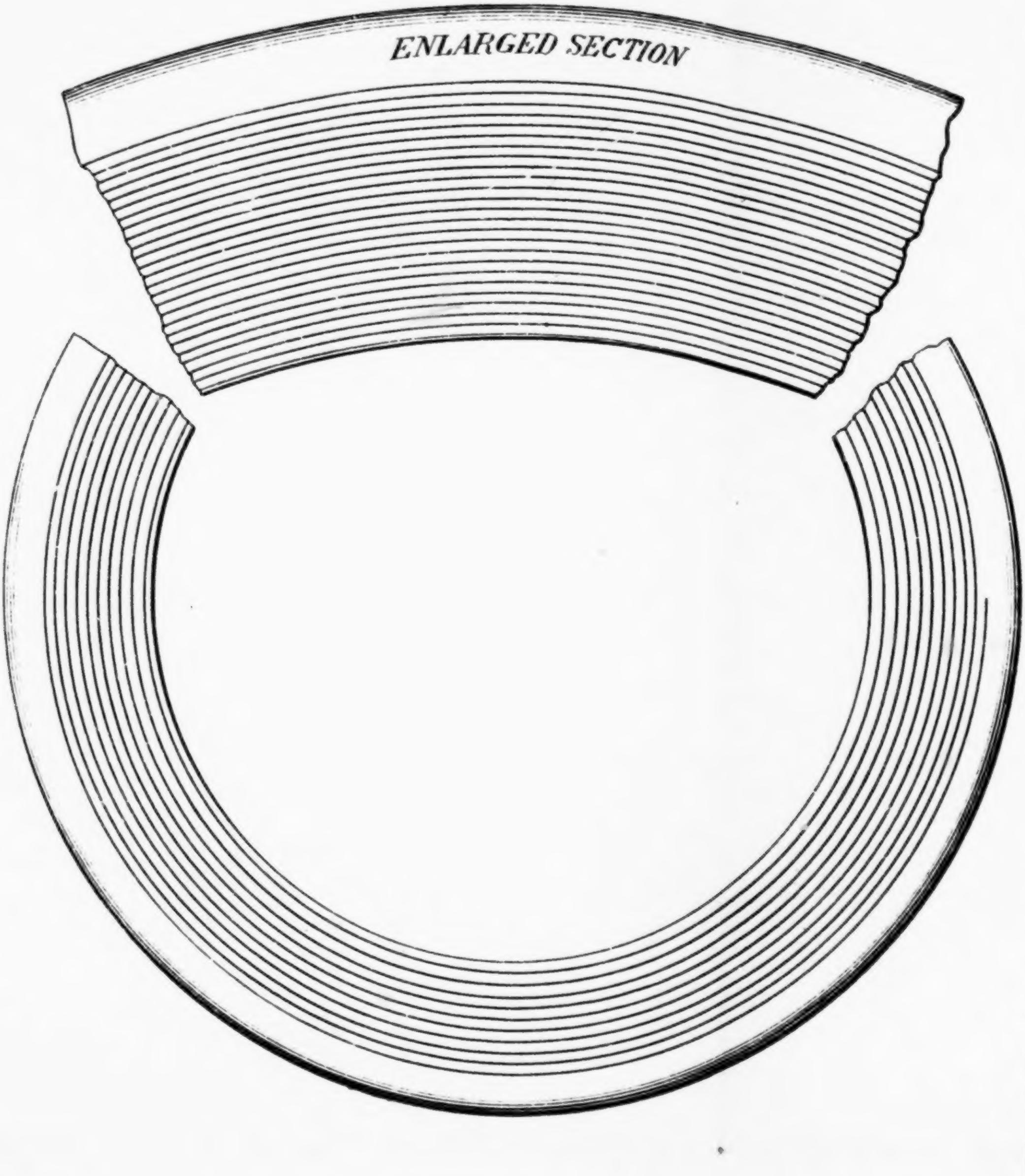


Plaintiff's Exhibit No. 11—Manual Circumferential Stretching.



Plaintiff's Exhibit No. 12.

STATE'S SPIRAL PATH



Plaintiff's Exhibit No. 13—Stevens Patent (1,253,105).

W. C. STEVENS.

MACHINE FOR MAKING TIRE CARCASSES.

APPLICATION FILED APR. 12, 1913.

1,253,105.

Patented Jan. 8, 1918.

9 SHEETS—SHEET 1.

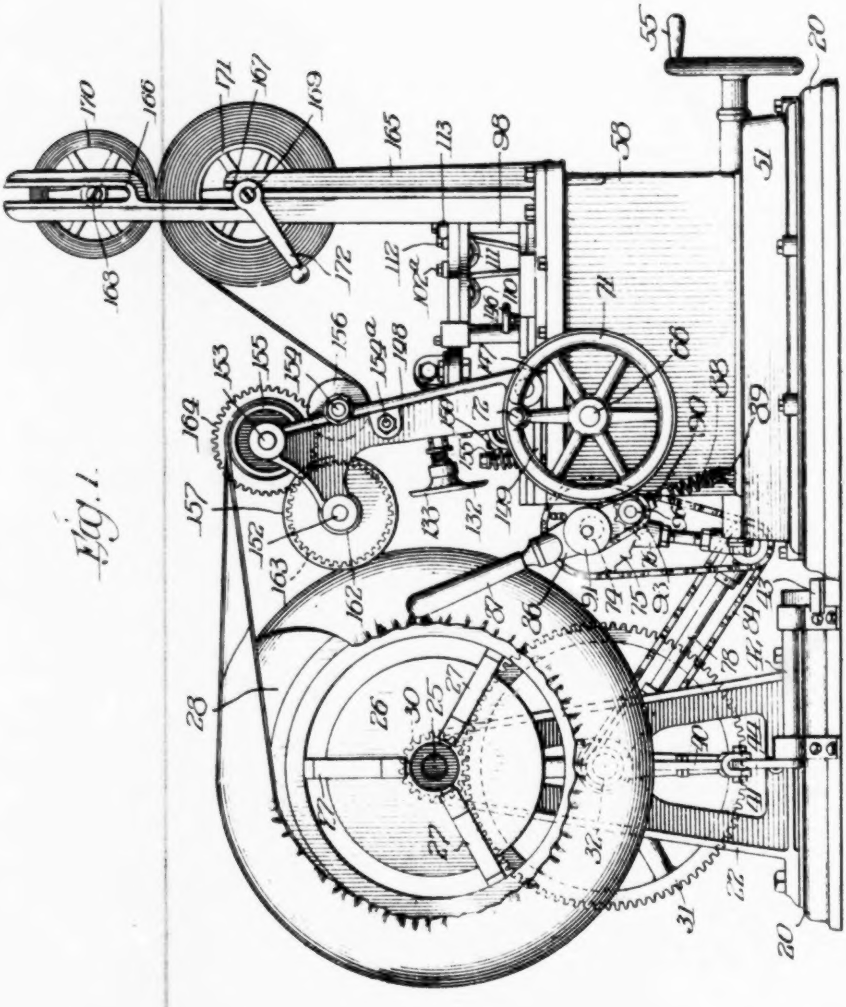


Fig. 1.

Witnesses

Geo. C. Dawson

Louis F. Greist

Inventor:

William C. Stevens

By Linthicum Belt & Fuller

Attys

W. C. STEVENS.

MACHINE FOR MAKING TIRE CARCASSES.

APPLICATION FILED APR. 12, 1913.

1,253,105. Patented Jan. 8, 1918.

9 SHEETS—SHEET 2.

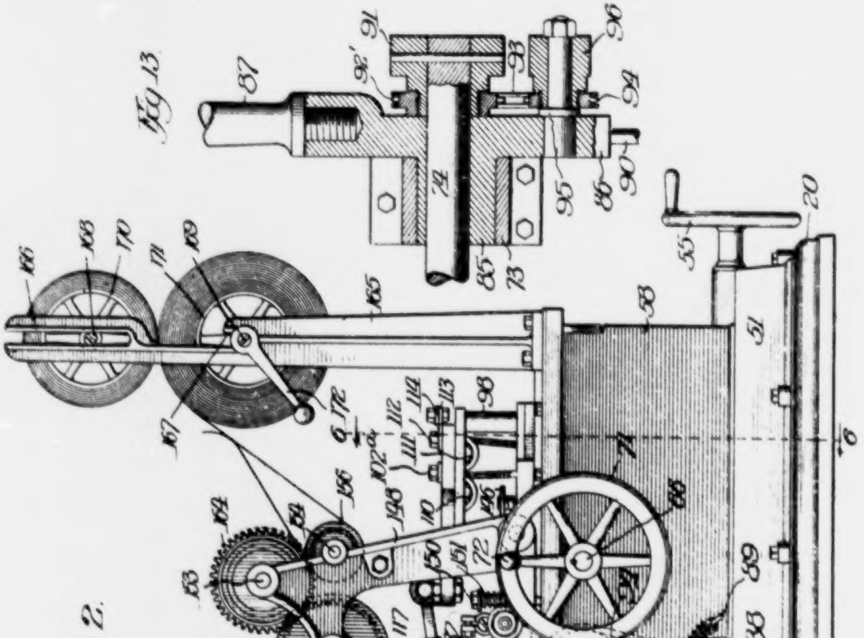


Fig. 13

Fig. 2.

Witnesses
Fred C. Davison
Louis F. Treist

Inventor
William C. Stevens
By Luthicum Belt & Fuller
Attys.

W. C. STEVENS.

MACHINE FOR MAKING TIRE CARCASSES.

APPLICATION FILED APR. 12, 1913.

1,253,105.

Patented Jan. 8, 1918.

9 SHEETS—SHEET 3.

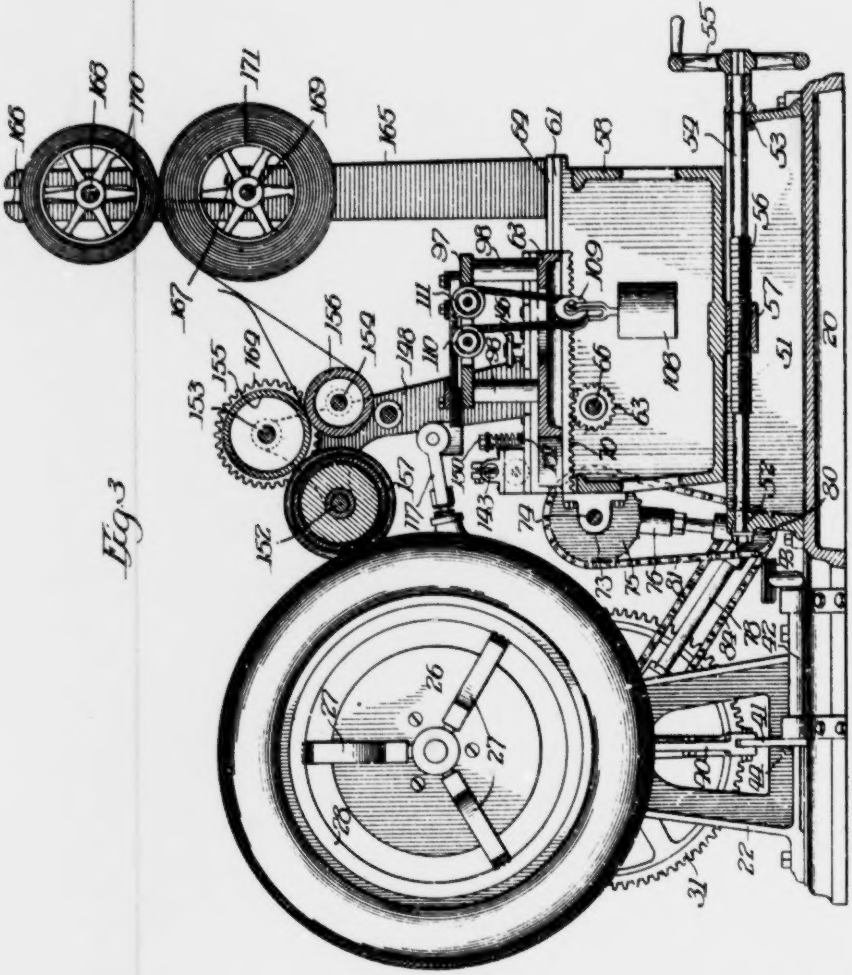


Fig. 3

Witnesses:

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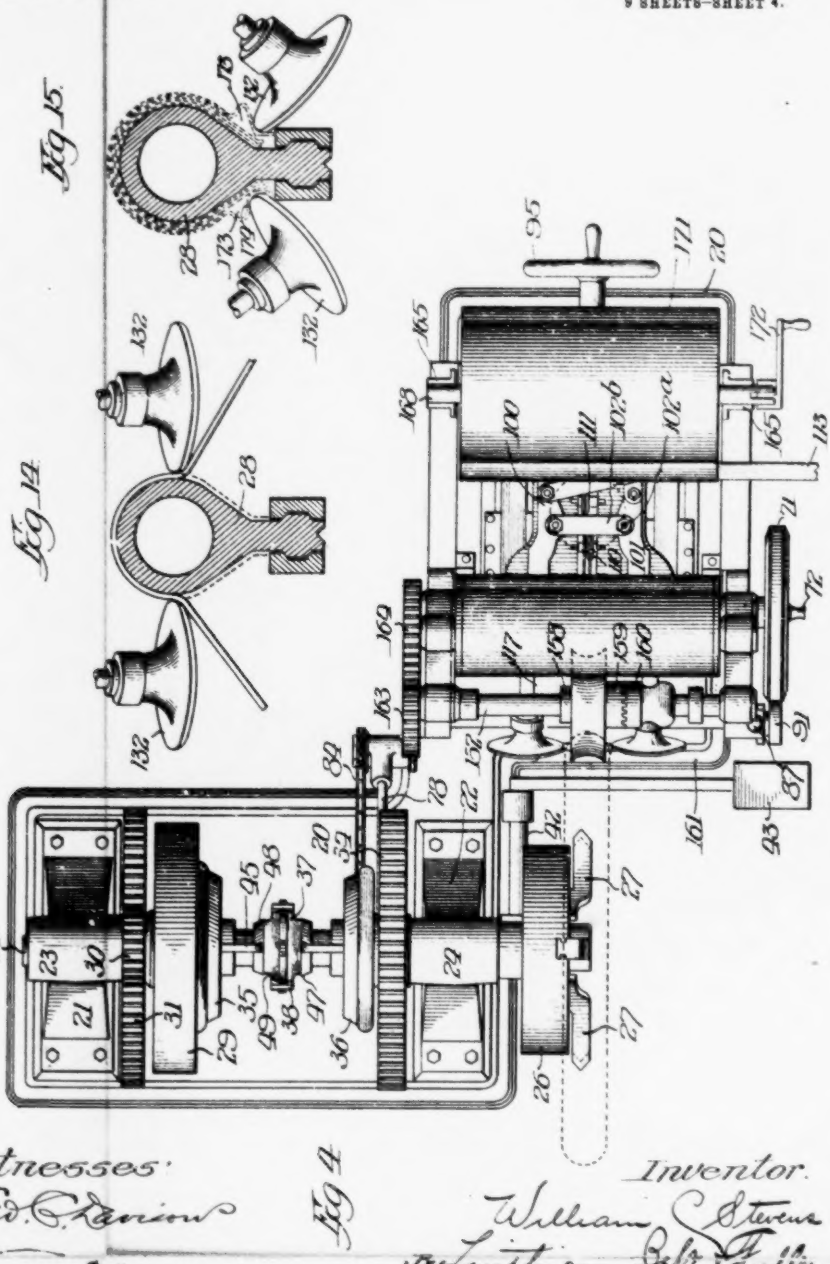

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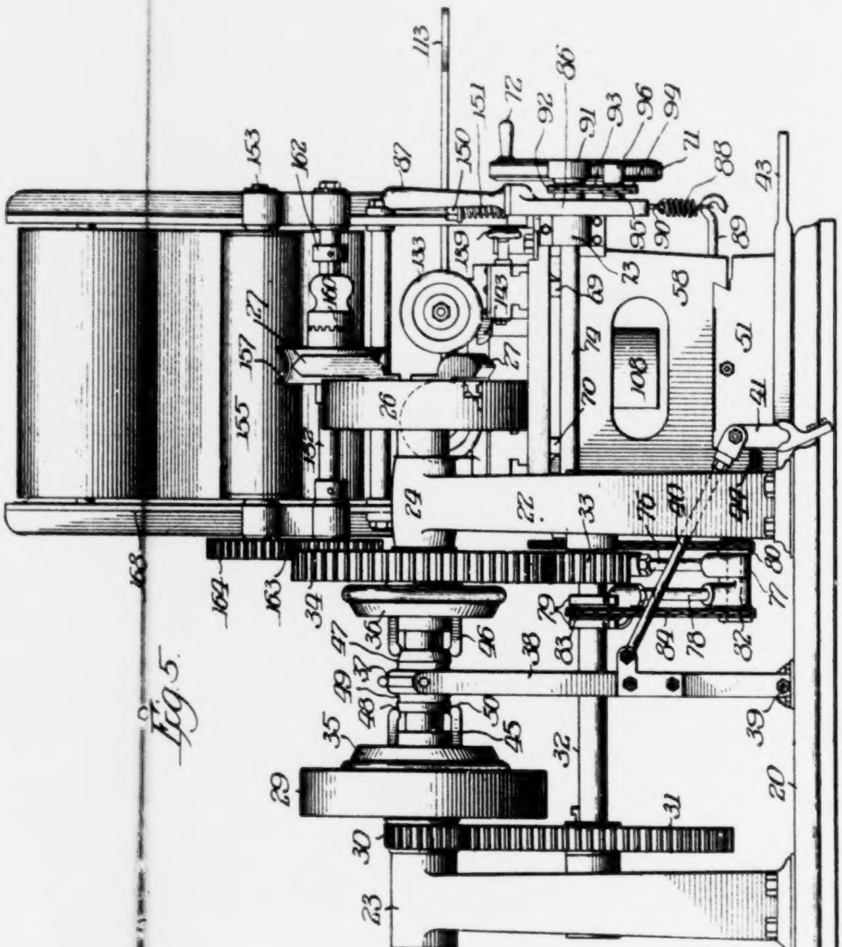

Fig. 5.

Witnesses:

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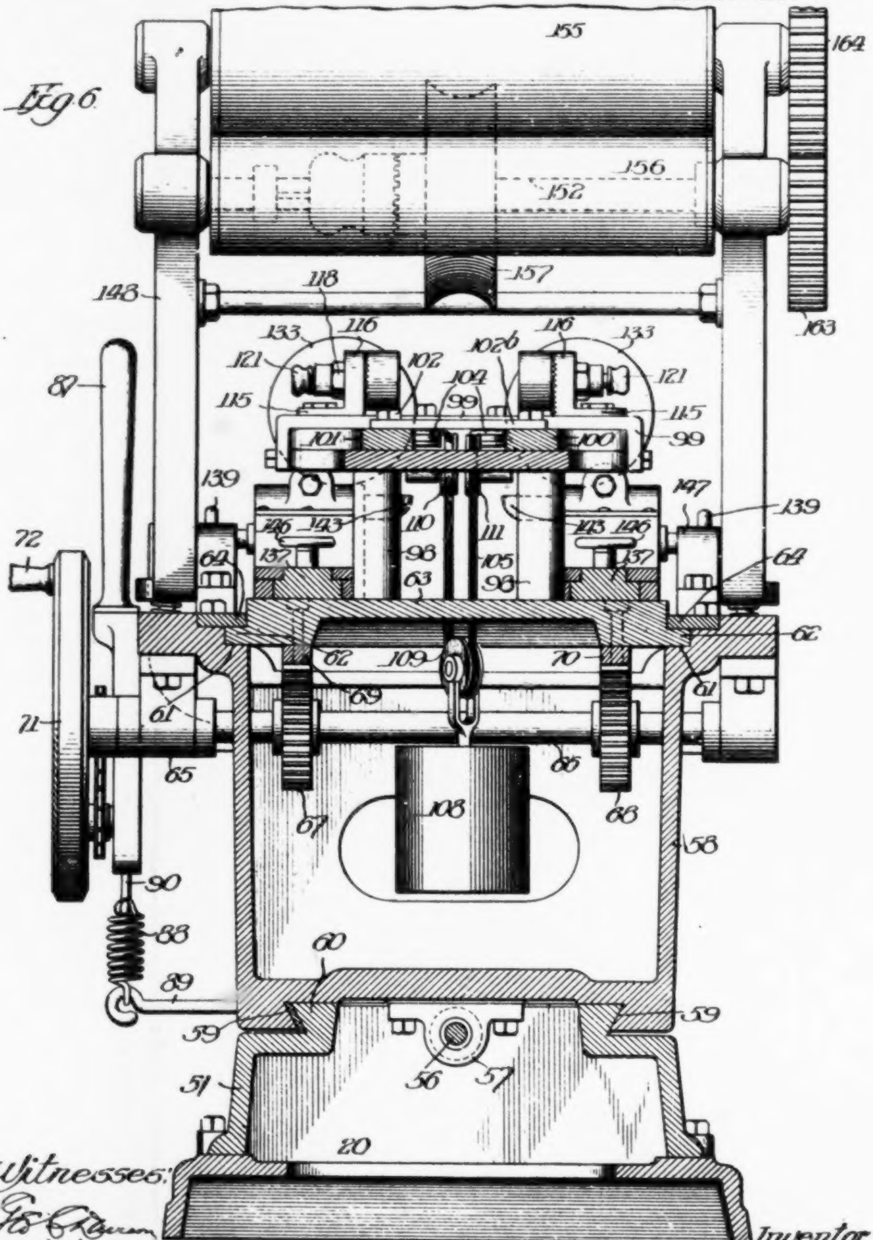
9 SHEETS—SHEET 6.

Fig. 6.



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9 SHEETS—SHEET 7.

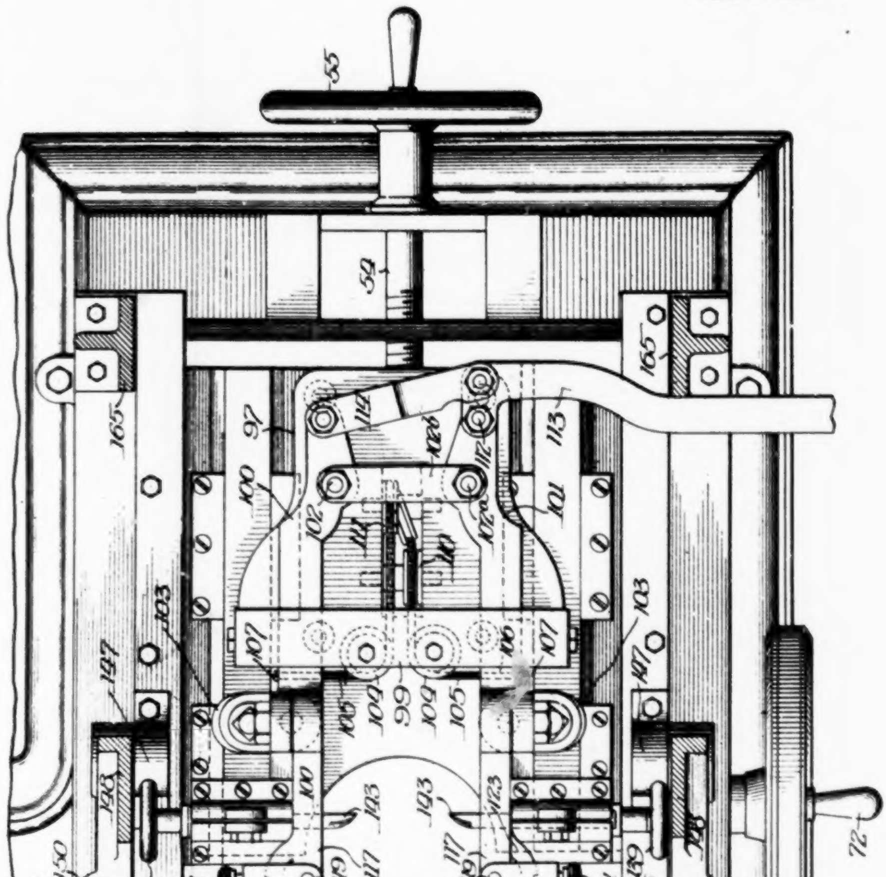

Fig 7

Witnesses:

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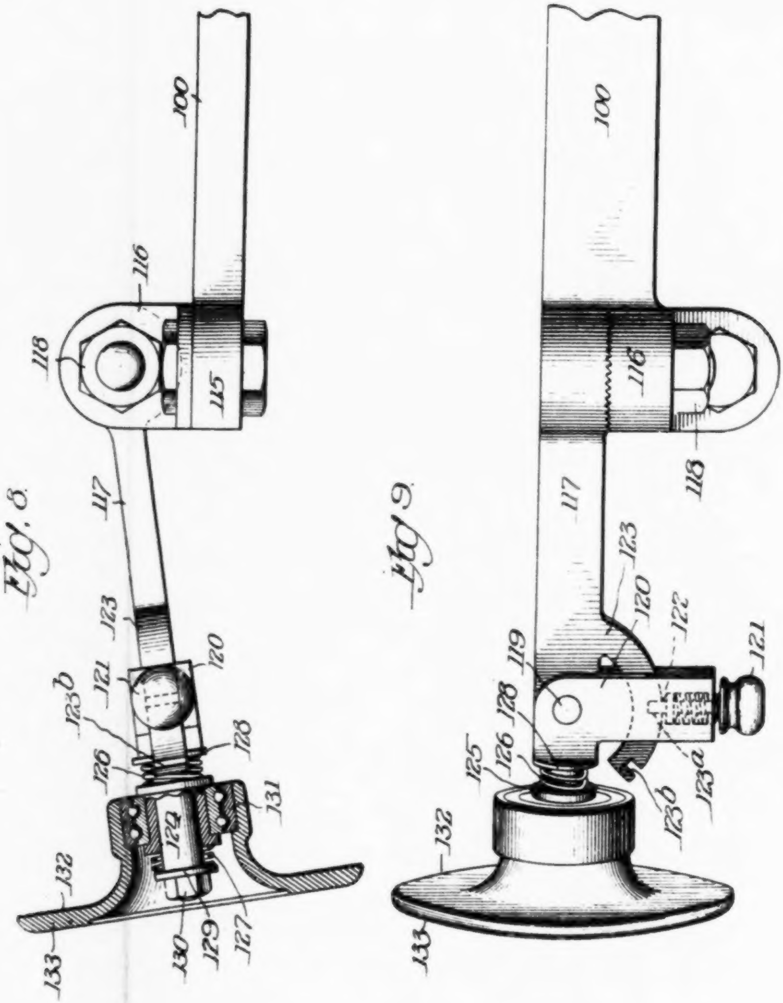

Fig. 8

Fig. 9

Witnesses
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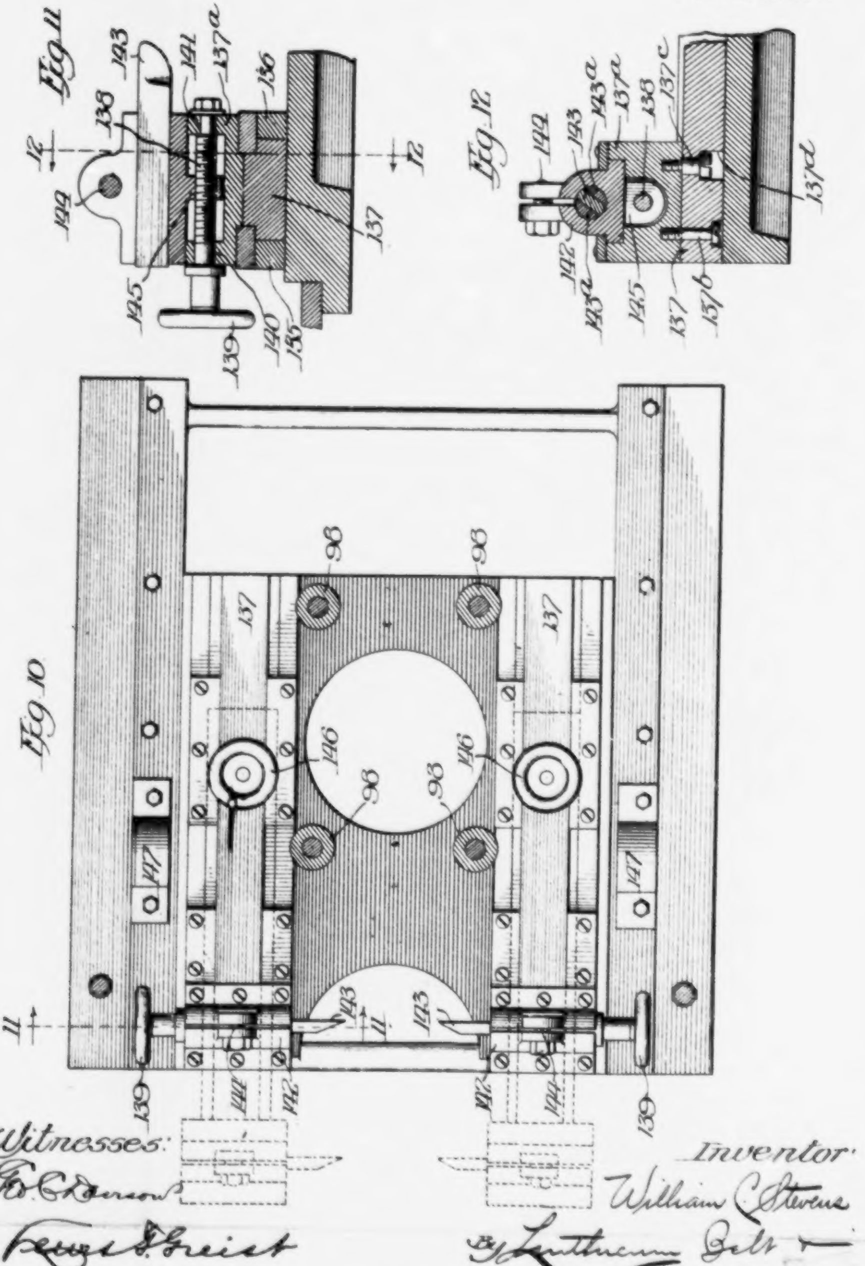
9 SHEETS—SHEET 9.



Witnesses:

Inventor:

William C. Stevens

UNITED STATES PATENT OFFICE.

WILLIAM C. STEVENS, OF AKRON, OHIO, ASSIGNOR TO THE FIRESTONE TIRE & RUBBER COMPANY, OF AKRON, OHIO, A CORPORATION OF OHIO.

MACHINE FOR MAKING TIRE-CARCASSES.

1,253,105. Specification of Letters Patent. Patented Jan. 8, 1918.

Application filed April 12, 1913. Serial No. 760,615.

To all whom it may concern:

Be it known that I, WILLIAM C. STEVENS, a citizen of the United States, residing at Akron, in the county of Summit, State of Ohio, have invented certain new and useful Improvements in Machines for Making Tire-Carcasses, of which the following is a specification.

This invention relates to appliances employed in the making of automobile, motorcycle, and similar tire-casings, or shoes, and concerns more particularly means for applying to and shaping on an annular rotatable tire-core, successive layers or plies of adhesive rubber-impregnated or frictioned tire-fabric, in such manner that the plies will all be stretched with proper uniformity to the same degree regardless of their differences in dimensions and other physical conditions, to give each other in the completed tire-structure mutual support by reason of their cumulative and uniform capacity for resistance.

Heretofore, machines have been constructed in which the tread-portion of the tire-fabric has been overstretched in order to cause the ply to conform roughly to the contour of the core and to reduce the amount of fullness or surplus in the fabric to be cared for or absorbed at the sides of the core, but in the use of these devices, in addition to the objectionable and weakening excessive stretching, wrinkles and other defects have occurred in those portions of the fabric applied to the sides of the core, dependence being placed upon a subsequent elimination of such wrinkles, either wholly or partially. The resulting detrimental effects of these defects thus occurring are not, however, completely overcome by the subsequent removal or smoothing out of the wrinkles or folds. In the operation of my improved machine, although the fabric is stretched only the required amount to maintain the finished tire-shoe or casing in normal shape and with proper strength, nevertheless, in applying the fabric to the sides of the core, no wrinkles or similar defects are permitted to form. In other words, I avoid the effects of and presence of such defects in the completed tire-casing or shoe by preventing their occurrence as the fabric is smoothed down on to the form or core, rather than placing dependence upon an attempted elimination of such faults after they have occurred.

In addition, another aim of the invention is the production of a tire-carcass or casing in the manner indicated on a machine of simple structure having a novel disposition of the fabric-smoothing and applying elements, the labor cost of constructing the tire-casing or shoe being materially reduced, as well as providing a more generally uniform product with better wearing qualities than it has been possible heretofore to produce.

The fulfilment of these and other objects and purposes will be understood and appreciated by those skilled in this art from a consideration of the following detailed description of a machine of this character representing a preferred embodiment of the invention, such machine being illustrated in the accompanying drawings forming a part of this specification, and to which reference should be made in connection with the specification.

In these drawings:

Figure 1 is a front view of the machine showing the parts of the mechanism in their positions during the fabric-stretching operation;

Fig. 2 is a similar view showing the positions of the parts during the fabric-smoothing and applying operation;

Fig. 3 is a longitudinal section through the machine, the parts being in the same position as illustrated in Fig. 2;

Fig. 4 is a plan view of the machine;

Fig. 5 is an end elevation;

Fig. 6 is an enlarged vertical cross-section on line 6—6 of Fig. 2.

Fig. 7 is an enlarged horizontal section:

Fig. 8 is a fragmentary elevation partly in section of one of the fabric-smoothing rollers and its support;

Fig. 9 is a plan view of the construction shown in Fig. 8;

Fig. 10 is a horizontal section illustrating the mountings for the trimming-knives;

Fig. 11 is a section on line 11—11 of Fig. 10;

Fig. 12 is a section on line 12—12 of Fig. 11;

Fig. 13 is a section through the eccentric bearing for one end of the shaft 74, and

Figs. 14 and 15 are sections illustrating the action of the fabric-applying rollers on the fabric.

Referring to these drawings, it will be

apparent that this machine is composed of two coöperating parts—one, the mechanism for supporting and rotating the chuck or spider and tire-form or core, and the other, the means for applying the plies of frictioned or similar tire-fabric to such form. I will first describe the construction of the form-supporting and revolving mechanism and then the fabric-stretching and applying means.

Rising from one section of a right-angle base 20, (Figs. 4 and 5), is a pair of standards or pillars 21 and 22, having at their upper ends alined bearings 23 and 24 accommodating a shaft 25 carrying at one end a universal expansible chuck or spider 26 equipped with three arms 27, adapted to engage and support the usual tire-form or core 28 on which the tire-casing or carcass is built up by the application of a plurality of plies of frictioned or adhesive tire-fabric. The form and style of this expanding-chuck is, of course, immaterial, so long as the tire-form or core can be readily applied thereto and removed from it with facility and despatch. In this art, the body of superposed layers or plies of adhesive rubber-impregnated fabric before the completion of the casing or shoe by applying thereto the tread and other parts, and the curing of the tire, is known as a carcass.

Between the bearings 23 and 24, shaft 25 has loosely mounted thereon a driving-pulley 29 rotated from any source of power, as by a belt, (not shown). Fixed to such pulley at one side thereof and also loosely rotatable on said shaft, I provide a pinion 30 meshing with a gear 31 keyed to a lower shaft 32 revoluble in suitable bearings in the standards 21 and 22. Shaft 32 is also equipped with a pinion 33 in mesh with a gear 34 loose on shaft 25, this train of gearing constituting the well known back gearing provided for a reduction of speed.

Pulley 29 is supplied with a clutch-mechanism 35, gear 34 also having a clutch device 36, either of which may be thrown into action by the shifting of a central common clutch sleeve 37 slidable in either direction on the shaft 25 by means of a yoke 38 pivoted to the base at 39 and connected by a link 40 with the crank-arm 41 upstanding from one end of a suitably journaled rock-shaft 42 having connected at its opposite end a pedal or foot-piece 43. In order to hold the yoke 38 and the slidable clutch-sleeve 37 in neutral or inoperative position, that is, centrally between the two clutch devices, with neither clutch active, I interpose between the arm 41 and the adjacent standard a coil-spring 44. Clutch 35 is provided with a plurality of arms 45 projecting in the direction of the sleeve 37 and the companion clutch 36 has similar arms 46. In order to expand these latter arms, the adjacent portion of the sleeve 37 is beveled at 47, and the other end of the sleeve 37 is likewise beveled or tapered at 48 and is in addition supplied with an annular recess 49 adapted to receive the enlarged ends 50 of arms 45, such co-action of the arms with the groove acting to retain the clutch-sleeve in its lefthand position as the parts are viewed in Fig. 5, against the retracting action of spring 44.

When it is desired to rotate the chuck and form or core slowly, during the application and stretching of the tread-portions of the plies, the operator steps on pedal 43, causing a shifting of the sleeve 37 to the right, as viewed in Fig. 5, rendering the clutch 36 active to couple gear 34 to shaft 25, bringing about a relatively slow rotation of the latter. When the operator desires to revolve the chuck and core more rapidly, as during the rolling down of the fabric and the trimming operation, he lifts the pedal 43 against the action of spring 44 by placing his toe beneath it, causing a sliding of the sleeve 37 to the left, thereby rendering clutch 35 active and maintaining the same in such condition because of the retention of sleeve 37 in the shifted position by the engagement of the enlarged ends 50 of the arms 45 in the groove 49. As will be readily understood, under these conditions, shaft 25 will be rotated rapidly because the pulley 29 is directly clutched thereto. To stop the rotation of the chuck and form for the removal of the core and carcass, for example, the operator presses gently on the pedal 43, permitting the sleeve 37 to come to neutral position, in which it will be maintained by the action of spring 44. If the operator desires to stop the rotation of the core after the completion of the stretching operation, he merely lifts his foot from the pedal and the latter will automatically rise to neutral position so that neither clutch will be operative.

The other portion of the right-angle base 20 has bolted thereto a hollow box-section 51 having journaled in its end-walls at 52, 53, the cylindrical end-portions of a shaft 54, which projects out of the box 51 at one end, the protruding portion having fastened thereto a handle 55 of any suitable form, (Fig. 3). The central section of shaft 54 is slightly enlarged and screw-threaded at 56, such part passing through a similarly threaded bearing or box 57 bolted to the bottom surface of a hollow box slide or carriage 58, shaped at 59, 59, (Fig. 6), to fit over and coöperate with the longitudinal dovetail-shaped rib 60 on the top of the supporting box-section 51. In its top, (Fig. 6), this carriage or main slide 58 is provided with a pair of guideways 61, 61, slidingly receiving the marginal guiding-ribs 62, 62, of an upper slidable-carriage 63, the ribs 62 being held in the guideways 61, 61, by suitable retaining-bars 64, 64, overlapping them and

bolted in place to the member 58. The latter has externally fastened thereto a pair of depending bearings 65, 65, rotatably accommodating a cross-shaft 66 supplied internally of the hollow-slide or carriage 58 with a pair of gears 67 and 68, the teeth of which mesh with those of two inverted racks 69 and 70 fastened to the bottom surface of the carriage 63, whereby the latter may be advanced and retracted. At the front of this machine, shaft 66 has fastened thereto a friction drive-wheel 71 equipped with a handle 72, which permits of the manual rotation of shaft 66 and the resulting travel of the slide 63, as will be obvious. In order to permit a power rotation of the shaft 66, I mount at the inner end of the hollow member or slide 58, bearings 73, in which is adapted to revolve a transverse-shaft 74 carrying at its inner end a sprocket-wheel 75 and one end of a spacing-link 76, (Figs. 1 and 3), which at its lower end is pivotally connected by a short-shatt 77 to the lower end of another spacing-link 78, the upper end of the latter being bifurcated at 79, (Fig. 5), and adapted to rock on shaft 32. At one end of shaft 77 I employ a sprocket-wheel 80 connected to the sprocket-wheel 75 by sprocket-chain 81, and at the opposite end of shaft 77 I employ a similar sprocket-wheel 82 operatively connected with another sprocket-wheel 83, fixed to shaft 32 between the arms 79, by means of a second sprocket-chain 84. It should be apparent from this construction that the shaft 74 is at all times rotated at a uniform speed through power delivered from the jack-shaft 32 by means of the sprocket mechanism described, the elbow or link connection permitting, as will be readily understood, the sliding of the carriage 58 back and forth without breaking or interfering with the shaft-driving connection referred to. In other words, the sprocket mechanism is capable of extension and contraction to accommodate itself to the position of carriage 58 and shaft 74.

Shaft 74, instead of being directly mounted in the bearing 73 at the front of the machine, is rotatably received in an apertured boss 85, (Fig. 13), forming a part of a lever 86 and rotatable in the bearing 73, the shaft-receiving aperture extending through the boss and lever being eccentrically disposed with relation to the cylindrical exterior of the boss. At its upper end, the lever 86 has fastened thereto an operating-handle 87, the combined lever and handle being held in normal position by a coil-contractile spring 88, (Fig. 1), secured at its lower end to a stud 89 projecting outwardly from the carriage 58, the upper end of the spring being fastened by means of an eye 90 to the lower end of the lever. At its forward end shaft 74 has fixed or pinned thereto a friction-roller 91 adapted by manipulation or rocking of the combined handle and lever 87, 86, to be thrown into and out of driving peripheral frictional engagement with the wheel 71 on shaft 66, and by this means the rotation of shaft 74 can be transmitted to shaft 66 to slide the carriage 63 and the various parts carried thereby described hereinafter.

Fixed to the hub of roller 91, (Fig. 13) between the lever 86 and the friction-roller, I provide a sprocket-wheel 92 co-acting with which is a sprocket-chain 93 passing around another sprocket-wheel 94 fixed to the hub of a smaller friction-roller 96 revoluble on a stud 95 secured to the lower end of lever 86. The roller 96 is also adapted by the rocking of the handle 87 in the opposite direction to be thrown into and out of frictional engagement with the edge of wheel 71, its rotation being derived by the mechanism described from the shaft 74. By means of these two rollers 91 and 96, the operator, by manipulation of the handle 87 may impart two different speeds of rotation to the shaft 66, which, of course, means two different speeds of advance of the carriage 63 and the parts mounted thereon.

A plate 97 is mounted on the carriage or slide 63 some distance above the same, by means of a plurality of supporting posts or pillars 98, and has fastened thereto and extended across the top of the same, a bridge-piece 99 beneath which is a pair of shaped bars or arms 100 and 101 fulcrumed on a pair of studs 102 and 102^a on the plate 97 and connected together above the arms by a strengthening cross-bar 102^b, each of the arms 100 and 101 having at its forward end an outward laterally-offset slotted-ear 103, (Fig. 7). This bridge-piece 99 on its under side and near its center, carries a pair of suitably mounted revoluble grooved pulleys or sheaves 104, 104, passing around which is a cord or cable 105, the two ends of which extend through holes 106 in the pair of arms 100′ and 101, the ends of the cord being knotted at 107 to prevent their withdrawal through the holes. This cord 105 supports a weight 108 provided with a supporting pulley 109, (Fig. 6), the cord also passing over two suitably arranged and properly supported pulleys 110, 111 disposed in vertical planes, as shown in Fig. 7. It should, therefore, be clear that the weight of the member 108 is imposed equally upon the two arms or bars 100 and 101, tending to draw them together, yet permitting each to have an independent individual movement and at all times, the pull on the two bars will be equal and unvarying. On the bar or arm 101 at 112, (Fig. 7), I fulcrum the short leg or end of a right-angle handle 113, and I connect such handle with the companion arm 100 by means of a link 114 pivoted to each.

Each of the slotted ends 103 of the fulcrumed arms 100 and 101, has adjustably bolted thereto a right-angle bracket 115 having an upstanding portion or ear 116 with a roughened face against which is held the end of an arm 117 in such manner as to be capable of vertical angular adjustment, the arm being held or maintained in the desired position by means of a bolt 118 passing through the parts 116 and 117. As is described hereinafter, each of these arms 117 carries at its other end a fabric-smoothing and applying roller, and this angular adjustment of the arm permits the roller to be tilted in a plane oblique to the path of rotation of that portion of the core being acted upon by the roller. In ordinary operation, these arms slope downwardly slightly to secure this desired tilting or obliquity of the roller.

Each of the arms 117 has pivoted thereto at 119 near its end, a right-angle member 120, one leg of which is equipped with a spring-pressed locking-detent 121, the inner end 122 of which is adapted to co-act with two notches 123ª, 123ᵇ, in a sector 123, integral or rigid with the arm 117, such construction of parts permitting angular adjustment of the member 120 in two positions, as will be readily understood. The other leg of the right-angle member has a cylindrical portion 124 mounted on which I employ a sleeve 125 received between a pair of coil-springs 126 and 127 encircling the shaft 124, each spring bearing at one end against an end of the sleeve 125 and at its other end against a washer 128 or 129, the latter and associated parts being held in proper assembled relation on the shaft 124 by a nut 130 secured on a reduced threaded end of the shaft. The sleeve 125, (Fig. 9), carries a ball-bearing 131 for a fabric-smoothing roller 132 of peculiar disk-like formation, the working-edge portion 133 of such roller being curved in approximately the form illustrated. As is clearly shown, the hub-portion of this roller houses and covers its ball-bearing and associated parts of the mechanism. The recess in the front face of the roller enables me to bring the nut 130 and other parts inwardly of such face so that the face is practically an unobstructed plane.

The member 120, as has been explained, is capable of angular adjustment in two positions around the stud 119, permitting the plane of the roller to be shifted as required, and the plane of such roller is perpendicular to the general plane of the core, being held in such position by the detent 122 engaging notch 123ª, except when shifted as described hereinafter.

The carriage or slide 63 is not only apertured at 134 for the passage therethrough of the weight-supporting cord or cable 105, the weight being received within the member 58, but it is also equipped at each side with a pair of guideway-members 135 and 136 acting as guides for a pair of slides 137. Each of such slides at its inner end carries a knife-holder 137ª angularly adjustable on the slide around a screw 137ᵇ and capable of being held in adjusted position by a tightening-screw 137ᶜ, which passes through a slot 137ᵈ in the slide 137. Each of the knife-holders 137ª has a transverse rotatable screw 138 supplied with a turning-handle 139, cylindrical portions of such screw being rotatable in suitable bearings 140 and 141 in the holder. Each holder also carries a split-clamp 142 provided with a cylindrical aperture therethrough for the accommodation of a trimming-knife 143 and two segments 143ª disposed on opposite sides of the knife and permitting an angular adjustment of the knife about its own axis in the clamp, the knife and segments being held in adjusted position by means of clamp-tightening screw 144. This clamp has a depending screw-threaded ear 145 through which the screw 138 passes, permitting transverse movement of the knife relatively to the slide 137 by turning the handle 139. In order that these slides may be fixedly held in proper adjusted position lengthwise of the guideways in which they are received, each has a set-screw 146 with a suitable handle for its tightening and loosening.

As is clearly shown in Fig. 10, the two knives 143, 143, extend inwardly toward one another and are adapted to be fed inwardly to trim off the surplus fabric at the inner edges of the finished carcass.

Also on the sliding-box or member 58, in suitable bearings 147, 147, I hinge two side-members 148 of a carriage or rocking-frame, each of such members having at its lower end a laterally-extended apertured arm 149 through the hole of which passes a screw 150 threaded at its lower end into a correspondingly threaded hole in the slide or carriage 58, and encircling such screws between their heads and the legs or arms 149, I employ coil compressing-springs 151 tending to rock the frame or carriage, composed in part of the side-members, in a direction toward the core. These two-side members are connected together by a pair of tie-rods 154 and 154ª on the former of which is loosely rotatably mounted a fabric guide-roller 156. Each of these side-members has bearings for two cross-shafts 152 and 153, the latter having fixed thereto a stretching drum 155 supplied with a friction-surface such as would be provided by applying to the drum a layer of rubber-impregnated frictioned fabric, such as is used in the building-up of the carcasses. Shaft 152 has loosely mounted thereon and centrally thereof, a retarding or checking-roller 157 with a soft-rubber

concave-face shaped to conform substantially to the curvature of the face of the tire-core 28. This roller bears against a collar 158 fixed to the shaft at one side thereof, and has fastened to its opposite face one toothed member 159 of a clutch mechanism, the companion member 160 of which is similarly toothed and provided with a handle 161, such member 160 being splined to and slidable on the shaft 152 so as to be capable of clutching the roller 157 to the shaft and unclutching it therefrom. The outward movement of the clutch-member 160 is limited by means of another collar 162 fixed to the shaft. When the roller 157 bears against or presses on the tire-core or the fabric-plies applied thereto, owing to the frictional engagement between the parts, they both have the same surface speed. In order that the stretching roller 155 may positively and uniformly travel at a surface speed different from that of the checking-roller 157, I employ a gear 163 on the end of shaft 152, which meshes with the gear 164 on the end of shaft 153 and so choose the size of the gears and the diameter of the stretching-roller that each ply will be given a definite uniform stretch throughout its central part.

On the carriage or slidable box 58, at one end, I mount a pair of upright standards 165, each provided with a pair of slotted bearings 166 and 167 for the reception of the ends of shafts 168 and 169 carrying the drums 170 and 171 respectively, the former being adapted to have wound up thereon the usual cotton cloth liner separating the plies on the drum 171 as such liner and plies are unwound from the latter drum. This upper drum 170 and as much of the liner as has been wound thereon, rest directly on the surface of the combined frictional plies and liner wound on the supply-drum 171 in a common and well known manner, so that as the latter is revolved to draw off a fabric ply the drum 170 is similarly rotated to wind up the liner thereon. Shaft 169 is equipped with a detachable handle 172 for a purpose hereinafter indicated.

The operation of this machine takes place substantially as follows:

The operator places in the bearings 167 a shaft 169 carrying a drum 171, having wound up thereon in proper sequence the supply of plies of rubber-impregnated or frictioned fabric, the layers of which are separated from one another by the ordinary cloth liner to prevent them from adhering to one another. As is usual in this art, these plies vary slightly both in length and width, the shortest and narrowest ply being the first to be placed on the core and the longest and widest ply being the last one to be applied to the carcass, this difference in length and width being required because of the gradually increasing diameter of the carcass both circumferentially and crosswise and also because the latter plies are placed over the beads. As is usual, these plies are cut on the bias to permit the adhesive rubber-impregnated fabric of the ply to be stretched lengthwise throughout its central part as it is placed on the form or core, for several purposes, among which is the reduction of the amount of fabric which must be pressed or condensed on the sides of the form to avoid wrinkles and similar imperfections.

The man having the machine in charge places the tire-form or core 28 on the universal expansion-chuck or spider 26 and expands or elongates the arms 27 so as to securely retain the core thereon, compelling rotation of the form or core with the shaft 25. Then the workman, by turning the handle 55, advances the carriage or slide 58 toward the form or core until the face of the checking-roller 157 engages the core, and then he turns the handle 55 still further, causing the carriage to advance somewhat more, bringing about a rearward rocking of the carriage or frame 148, 148, 154 and 154ª in the bearings 147 until the feet 149 are raised slightly above the carriage 63 against the downward pressing action of springs 151, such elevation of these feet indicating to the operator the proper position of the carriage. The slide 58 and appurtenant parts remain in this position until the carcass is completed.

Now the workman draws the advance or front end of the first ply of fabric from the supply roll, passes it beneath the loose guide-roller 156 and over the retarding or stretching roller 155, and causes its front end, which is cut off diagonally, to adhere to the form by means of cement, it being understood that the ends of the various plies of fabric on the supply drum are overlapped and thereby temporarily spliced together so that as each ply of fabric is stretched on the core the next succeeding ply assists in the stretching operation, forming an elongation or extension of the ply which is being stretched. In other words, the ends of the adjacent adhesive plies wound up on the supply-drum 171 are stuck together so as to constitute a continuous length of material separable into plies or sections, however, as required.

The person in charge of the machine steps on the pedal 43, throwing the clutch 36 into action, causing a relatively slow rotation of the shaft 25 and the core by means of the back-gearing 30, 31, 32, 33 and 34. During such rotation of the form or core, the clutch-members 159 and 160 are in operative engagement, whereby the rotation of the stretching roller 155, which has a tendency owing to the fabric passing over it to revolve at the same surface speed as the core is checked or restrained by the frictional engagement of the retarding or checking-

roller 157 with the surface of the core. In other words, the roller 155 tends to rotate more rapidly than it actually does, the roller 157 being prevented from more rapid rotation owing to its frictional and checking engagement with the face of the core. Driving contact of the retarding or checking roller 157 with the surface of the core is obtained by the pull of the fabric exerted by the core in its rotation and also by the weight of the hinged frame carrying the stretching mechanism. Because of this positive, uniform, slower, surface speed of the stretching roller 155, and because of the fact that the core is rounded in cross-section, the central zone or middle portion of the fabric ply is stretched longitudinally uniformly throughout its length, and is at the same time, stretched somewhat cross-wise, causing it to adequately, smoothly, and properly adhere to the outer or tread-portion of the core, requiring no rolling or further shaping treatment. This rotation of the core, of course, automatically unwinds the ply and a part of the next succeeding ply from the sup ply-drum 171.

When the core has completed one revolution, the operator removes his foot from the pedal 43, which automatically swings up under spring action, throwing the clutch 36 out of operation, that is to say, the rotation of the form or core stops, and, during such cessation in the rotation, the man breaks the overlapping splice between the last end of the first ply and the advance end of the second ply, and by means of the handle 172 on the shaft of the supply-roller, rewinds on the latter a portion of the second ply and its liner, the remainder of the second ply being temporarily folded back over the roller 156 out of coöperative relation with the stretching-roller 155.

The first ply of adhesive fabric having been thus stretched on the form and its two ends overlapped the required amount to form a proper splice or joint, it will be found that its central section corresponding to the tread-portion of the tire is shaped to and caused to adequately adhere to the form without wrinkles, air-bubbles or other defects, during such relatively slow rotation of the form and not by the action of the roller 157 which runs over a part of its surface, but rather by the stretching operation itself, the stretching not only elongating the central section of the ply but causing its proper application to the peripheral part of the form. It being understood that each ply is individually stretched on the core and then smoothed down into position on the sides of the core before the next ply is stretched and applied, the ply now on the form is ready for the application of its side-portions to the side faces of the core, such smoothing of the fabric causing its adhesion to the core being accomplished at a higher speed of rotation of the latter than that used during the stretching.

The sides of the form having been coated with cement to secure the proper attachment of the fabric thereto, the operator lifts the pedal 43 by placing his toe beneath it and thereby renders the clutch 35 operative, so that the shaft 25 and the core are rotated directly at a more rapid speed by the pulley 29. The man then by grasping the handle 113 and shifting it to the left separates the rollers 133, and by turning the wheel 71 by the handle 72, advances the carriage 63 until the rollers are opposite the places on the core at which they are to begin their operation. The operator releases handle 113 permitting the weight 108 to pull the rollers toward one another, that is, toward the core, with an equal pressure due to the action of weight 108. He then shifts the handle 87 to the right so as to cause the constantly rotating wheel 91 to frictionally engage the edge of wheel 71, and in this way mechanically and uniformly advances the carriage and rollers toward the axis of the core, these rollers, owing to the action of weight 108, readily following the contour of the core and being pressed toward the core under equal pressures uniformly throughout their traverse.

The core, as is usual in machines of this kind, during the smoothing-down action, is rotated quite rapidly as stated, and the effect of this rotation is to spread out somewhat skirtwise and substantially free from wrinkles, any unattached parts of the ply which is undergoing attachment. During this rapid rotation of the core the springs 151 are useful to prevent the roller 157 and the swinging-frame 148 from bouncing or jumping unduly as the roller passes over the overlapping ends of the ply. The shaping-rollers act upon the fabric just at the junctions of the skirtwise-spread, practically unwrinkled portions with the attached portions. Each of the shaping or smoothing-rollers as has been explained, is desirably tilted in a plane slightly transverse or oblique to the path of rotation of that zone of fabric which the roller is acting on, with the advance edge of the roller more remote from the axis of the core so as to effect an inward wiping, smoothing, and squeegee action on the fabric as it presses it down into place on the core or in the case of later plies, on one of the plies below. Due to this disposition or inclination of the rollers, the latter crowd or press the fabric as they apply it in the general direction of rotation of and progressively toward the center of the form, thereby efficiently and adequately condensing or compressing the fabric to prevent the occurrence of wrinkles, folds, or similar defects, in the applied ply.

Owing to the fact that the ply is cut on the

bias, this wiping action of the fabric-applying roller inwardly toward the axis of the core and also in the direction of rotation of the core, due to its tilted position, results in a stretching of the fabric radially or transversely of the core, thereby bringing about a circumferential contraction or shortening of the belt or zone of fabric acted upon by the roller, and the next adjacent belt or zone, in this way preliminarily preparing the latter for its application to an adjoining portion of the core naturally of somewhat lesser diameter. In this manner the roller progressively causes the adhesion of the fabric to the core, first shortening each zone or belt before rolling it down into place. It should be clear that such tilting of the roller not only stretches the fabric transversely of the core, but also condenses or compacts the fabric circumferentially to absorb the fullness.

The working-face of the stitching-roller is essentially that of a rounded edge. It must be sharp enough to produce under pressure the scraping or rubbing effect upon the fabric heretofore referred to, but it must not be sharp enough to cut or abrade the fabric. The fabric-shaping disk or roller should also have a diameter sufficient to give the effective line or tangent of contact a perceptible length, that is, this line of contact should be something considerably more than a mere point. My preferred form of fabric-shaping element is a disk with one face practically flat, the other face being substantially parallel to the first up to near the edge where it is sloped or rounded off to meet the first or back face. This enables the roller to work down closer and more effectively into and over the recess caused by the bead on the tire when the later plies of fabric are worked into place. At the same time, the rounded edge which progresses first in the inward movement of the tool enables me to meet the sharp curve of the bead and to shape and finish this off to good advantage and to prepare the fabric as indicated above for the completer work of the sharper edge. This arrangement of the edge I have found to be perhaps the best in practice. There is just enough dragging action owing to the tilt of the disk to stretch and smooth the fabric properly, while the edge instead of traveling in a line has a path of appreciable width. Its effect is thus better and more uniformly distributed over the fabric. In making tire-casings by hand the operator with one hand pulls or stretches the fabric at intervals toward the center of the core, while with the other hand he works the applying-tool. (a disk-like roller mounted in a handle), by a series of strokes directed tangentially and slightly inwardly on the face of the fabric covering the core, and thus tries to fit and smooth the fabric on the core. My device does this with uniformity and regularity, while the essentially different manually-performed series of acts just alluded to are apt to be more or less inaccurate owing to the possible vagaries and inattention of the operator and the uncertainties of his personal equation.

It will, of course, be understood and appreciated that the parts of this mechanism are so constructed and related to one another that during the inward travel or advance of the rollers from a position adjacent to the tread-portion to the inner part of the core, the latter makes many revolutions, the inward travel of the roller's being progressive and gradual so that they act in sequence upon successive zones or portions of the unapplied fabric to apply them or cause them to be attached to the core in the manner indicated above.

Instead of releasing the handle 113 during this fabric-applying action, the operator may retain such handle in his hand and augment the action of the weight 108 on the rollers, and by holding the handle, may steady somewhat the action of the rollers as they pass over the splices. This, however, is not absolutely essential since the weight itself can satisfactorily perform this function.

The rollers having reached the inner edges of the ply, the operator by means of the handle 113 separates the rollers and by releasing the handle 87 and manually turning the wheel 71 by means of the handle 72, the carriage on which the rollers are mounted is retracted out of operative position ready for the application and stretching of the second ply on top of the first ply. The man working the machine presses on the pedal, permitting it to resume its neutral position, thereby stopping the rotation of the core. He then takes the advance end of the second ply, brings it over the retarding roller 155 and presses it down by hand on top of the first ply. He then slides the clutch-member 160 into engagement with the companion clutch-member 159, the part 160 having been out of such co-action during the previous operation. He again steps on the pedal and brings about the slow rotation of the core during which the second ply is stretched on the core over the first ply in the same manner that the latter was stretched on the core. In attaching the advance end of the second ply to the first ply, the operator is, of course, careful not to cause an overlapping of splices on the tread-portion of the core. The second ply is stretched in substantially the same manner as the first ply, the rotation of the core then stopped, the splice or joint attended to, and the ply is then smoothed down in place on the sides by the rollers as was the first ply at the higher

speed of rotation of the core, bringing about a proper unwrinkled application of such second ply on top of the first, to which it adheres as will be readily understood.

This operation is repeated a sufficient number of times to build up the plies one on another until the desired thickness has been secured; then two circular beads 173, 173, (Fig. 15), are placed on the sides of the carcass under process of construction and caused to adhere thereto. The next ply of frictional fabric, after having been stretched over the underlying plies is rolled down by the disks or rollers in the same manner as the preceding plies until such rollers reach the beads. Then, owing to the rather abrupt curved surfaces of these beads it is desirable that the smoothing-rollers travel inwardly more slowly, and to effect this the operator shifts the handle 87 to the left as the parts are viewed in Fig. 2, bringing the smaller friction-roller 96 into contact with the edge of wheel 71 and the larger friction-roller 91 out of such contact. During such slower inward advance of the rollers over the beads, the operator, if he desires, although it is not absolutely necessary, may decrease the inward pulling-action of the weight 108 on such rollers by applying pressure on the handle 113 in opposition to the inward pull of the weight, and in this way all tendency to dislodge the beads is overcome and the application of the fabric to the underlying plies and to the bead itself neatly effected. It will be noted that owing to the tilted arrangement of the disks, they are given a tendency to traverse the rather steep faces of the beads, and this tendency is accentuated by the shape of the edge of the disks, so that the disks owing to these foregoing characteristics pass in their traverse easily over the faces of the beads, and smooth the friction fabric down upon the beads and settle the latter into permanent position on the sides of the carcass. Owing to the yielding mountings of these disks or rollers on their supporting fulcrumed arms, they may shift position somewhat axially, against the centering action of the opposed springs 126 and 127 and automatically accommodate themselves to any slight irregularities of the beads.

When these rollers reach the inner abrupt faces 174 of the beads, that is, the surfaces between the clench or heel and toe of the beads, the operator releases the handle 87, permitting it to automatically resume its neutral position as determined by the action of spring 88, throwing the friction-wheel 96 out of coöperative relation with the wheel 71. The angular adjustment of the rollers is then shifted to the position indicated in Fig. 15, the rollers or disks being held in their new adjusted position, as will be readily understood, by the coöperation of the catches or detents 121 with the notches 123^b. This shifting of the position of the rollers is done to permit them to accommodate themselves more efficiently to the surfaces on which they are about to act. By grasping the handle 72 the operator holds the shaft 66 from turning, that is, holds the carriage from movement, and then by manipulating the handle 113 the tilted rollers are fed directly in back of the beads, applying the fabric without wrinkles or other defects to the abrupt faces 174, the advance edges only, of the disks being operative.

After the required number of plies have been placed on the core in the manner indicated, both beneath and over the beads, the pair of slides 137 are adjusted and held in adjusted position by the set-screws 146, and then the trimming-knives 143 are advanced or fed inwardly toward one another by turning the screws 139 so as to trim off the surplus material at the inner side of the carcass, that is, at the toes of the beads. During this trimming-operation the form is revolved at the same relatively high speed at which the rolling down or smoothing of the fabric is done. Then the trimming-knives are retracted, the slides pushed back, the carriage 63 slid back, and the core and tire-casing or carcass thereon removed from the chuck ready for finishing and curing and the machine is now in condition for the reception of a new form or core. It might be observed, however, that owing to the universal adjustment of which the trimming-knives are susceptible, the trimming is accomplished with effectiveness and despatch.

It should be noted that in the actuation of this improved machine during the stretching-operation, the middle-section of each ply of fabric is stretched longitudinally a definite percentage of its original length, such stretching being occasioned by the pulling-action of the form and the retarding or holding back action of the roller or drum 155. Since the concave checking-roller, desirably made of soft rubber, travels on the surface of the form, or the outermost ply if several plies have been placed on the form, the stretching of the layer or ply of fabric being applied is determined by the length of the surface on which the roller travels so that a definite percentage of stretch is brought about in each ply regardless of its original length, the various plies varying in their original length, being preliminarily cut in accordance with the usual practice.

Owing to this manner of applying these layers or plies, the middle zone of each one is stretched uniformly throughout its length and with the same degree of stretch that is given to all other plies. In this way in the finished product, each ply reinforces the others and is in turn reinforced and strengthened by them in their pressure-re-

sisting qualities. The result is a carcass or tire-casing of remarkable strength and uniformity in its various characteristics.

Heretofore it has been proposed to use a friction band-brake to retard or brake the action of the stretching-roller, but these constructions have proved to be unsatisfactory in service owing to the lack of uniformity in the retarding-action of the brake on the roller, particularly when acting on plies of different temperatures. If the ply of fabric is being applied in a room relatively cool, a greater force or pull is necessary to obtain a certain degree of elongation or stretch, whereas if the same ply is stretched in a room of higher temperature the force necessary to stretch it is not so great, consequently, when a band-brake is employed it should be either adjusted to meet the different temperature requirements or else the amount of stretch in the plies will not be uniform. In my construction, however, owing to the positive connection between the stretching-roller and the retarding or checking-roller the amount of elongation given to each ply is necessarily the same percentage of its original length, the result being a tire-carcass possessing more uniform and greater strength than those heretofore produced.

To those skilled in this art, it will be apparent that some initial stretching of the fabric plies during the making of the tire-carcass is necessary in order to prevent undue enlargement or expansion of the casing or shoe when its inner tube is blown up, and it is carrying its load. It is important, however, that the plies should not be overstretched as has been customary in other tire-making machines which I am acquainted with, such undue stretching causing the casing to be weak when the load and pressure are applied, but on the other hand, if the plies are understretched the shoe or casing fails to keep its shape and to wear to the best advantage. This improved machine is so designed as to give the plies the proper percentage of stretch throughout their middle zones or sections. This, of course, means that a greater amount of fullness or surplus of stock must be absorbed in the sides of the tire than in those instances where the middle-portions of the plies are overstretched, but my mechanism efficiently applies the side-sections of the fabric plies to the core without defects, depending upon the principles of operation hereinabove outlined.

When plies are stretched on a core by hand, the workman grasps the edges of the ply and by pulling thereon causes an elongation or lengthening of the central section of the ply because of the rounded contour of the core, but he also at the same time stretches these side-sections which necessarily means an extra amount of fullness which must be condensed in the sides of the carcass. In this machine, however, the stretch of the side-portions is reduced to a minimum, thereby overcoming this obvious objection to hand-stretching.

Since my fabric-applying rollers are capable of yielding in practically all directions, their travel over the fabric and the splices is facilitated, without varying the pressure of the rollers on the fabric brought about by the action of a common weight on the two arms carrying the rollers. Another point of advantage in this construction is that the same rollers can be used on all parts of the tire, with the exception of the central section of the tread which is applied and caused to adhere in position during the application of the ply to the form, that is, during the stretching operation itself. It is also to be noted that another feature of superiority resides in the fact that no form-shields or shield-rollers are necessary for applying or guiding the fabric to the core. The structure of this mechanism is not only simple and inexpensive to produce, but the manufacturer is not required to have different machines for different sizes of cores and carcasses, because all ordinary sizes of tires can be made on one machine without adjustment or extra tools, it being merely necessary to use different forms or cores and pieces of frictioned fabric of appropriate size.

These machines can economically produce tire-casing carcasses because they can be operated at a relatively high speed, and although I provide means for reducing this speed of travel of the rollers over the beads, it should be borne in mind that such portions of the carcasses form a relatively small part of the whole, and it will be clear that the various parts of the carcass because of this change of speed, are built up and constructed with a maximum degree of economy of production.

While I have herein set forth with some degree of particularity and minuteness a description of the construction and operation of a preferred embodiment of this invention, it should be borne in mind that many mechanical changes may be made in the structure set forth without departure from the substance of the invention, and without the sacrifice of any of its substantial benefits and advantages. For instance, I have herein outlined a construction wherein the core or form revolves and the rollers remain relatively stationary, but of course, this operation could be reversed.

Whereas above I have described the fabric-applying roller as being tilted in a plane oblique to the path of rotation of the core at the point of action of the roller on the core, it is to be understood that this need be only a relative obliquity between the roller and such path of rotation, the essential feature

being to give the roller an effective action upon the fabric in a path of appreciable width to accomplish the result referred to.

Above I have stated certain theories regarding the action which the various instrumentalities of the mechanism bring about on the frictioned fabric, but these theories are to be considered as illustrative only of the action, and I do not wish to be strictly bound thereby since the results brought about in the fabric by the action of this machine are novel and unusual. While they afford a good working basis for an understanding of the operation of the machine they may not be wholly free from error and for that reason I do not wish to be restricted and necessarily bound to them.

I claim:

1. In a tire-machine, the combination of a revoluble tire-core, a fabric-applying member located in a plane oblique to the path of rotation of the core at the point of action of such member on the core, and means to cause said fabric-applying member to travel in a spiral path over the core, substantially as described.

2. In a tire-machine, the combination of a revoluble tire-core, a fabric-applying roller located in a plane oblique to the path of rotation of the core at the point of action of the roller on the core, and means to cause said fabric-applying roller to travel in a spiral path over the core, substantially as described

3. In a tire-machine, the combination of a revoluble tire-core, a fabric-applying member located in a plane oblique to the path of rotation of the core at the point of action of the member on the core, means yieldingly pressing said member toward the core, and means to cause said fabric-applying member to traverse the side of the core in a spiral path, substantially as described.

4. In a tire-machine, the combination of a revoluble tire-core, a fabric-applying member located in a plane oblique to the path of rotation of the core at the point of action of the member on the core, and means to feed said member inwardly toward the core-axis, whereby such member may act on successive portions of the tire-fabric to apply the same to the core or a previously applied underlying ply of fabric on the core, substantially as described.

5. In a tire-machine, the combination of a revoluble tire-core, a fabric-applying member located in a plane oblique to the path of rotation of the core at the point of action of the member on the core, means yieldingly pressing said member toward the core, and means to feed the member inwardly toward the core axis, whereby said member may act on successive portions of the tire-fabric to apply the same to the core or a previously applied underlying ply of fabric on the core, substantially as described.

6. In a tire-machine, the combination of a revoluble tire-core, a fabric-applying roller located in a plane oblique to the path of rotation of the core at the point of action of the roller on the core, means yieldingly pressing the fabric-applying roller toward the core, and means to feed the roller inwardly toward the core-axis during the rotation of the core, whereby the roller may act on successive portions of the tire-fabric to apply the same to the core or a previously applied underlying ply of fabric on the core, substantially as described.

7. In a tire-machine, the combination of a revoluble tire-core, a fabric-applying member, means tending to move said member toward the core, means to feed said member inwardly toward the axis of the core, whereby the member acts on successive portions of the tire-fabric to apply the same to the core or a previously applied ply of fabric on the core, and manually-operable means to regulate the action of said moving means on said member, substantially as described.

8. In a tire-machine, the combination of a revoluble tire-core, a pair of fabric-applying rollers adapted to act simultaneously on opposite sides of the core, means to press said rollers toward the core during the entire application of the fabric, means to feed said rollers inwardly toward the core-axis, whereby the rollers act on successive portions of the tire-fabric to apply the same to the core, or a previously applied underlying ply of fabric on the core, and a manually-operable means adapted to regulate the action of said roller-moving means on said rollers, substantially as described.

9. In a tire-machine, the combination of a revoluble tire-core, a pair of fabric-applying rollers adapted to simultaneously act on opposite sides of the core, means common to both of said rollers acting to move them with an equal pressure toward the core during the entire application of the fabric, means to feed said rollers inwardly toward the core-axis, whereby the rollers act on successive portions of the tire-fabric to apply the same to the core or a previously-applied underlying ply of fabric on the core, and a manually-operable means to regulate the action of said moving means on said rollers, substantially as described.

10. In a tire-machine, the combination of a revoluble tire-core, a fabric-applying roller, means to move said roller toward the core during the entire application of the fabric, means to exert on said roller a uniform pressure toward the core at all positions of the roller on the core, means to feed said roller inwardly toward the core-axis,

whereby the roller acts progressively on successive portions of the tire-fabric to apply the same to the core or a previously applied underlying ply of fabric on the core, and manually-operable means to modify the action of said roller moving means, substantially as described.

11. In a tire-machine, the combination of a revoluble tire-core, a pair of fabric-applying members adapted to act simultaneously on opposite sides of the core, means common to both of said members to exert the same uniform pressure toward the core on both of the members at all positions of the latter on the core, means to feed said members inwardly toward the core-axis, whereby the members act on successive portions of the tire-fabric to apply the same to the core or a previously applied underlying ply of fabric on the core, and manual means to modify the action of said pressure-applying means on said members, substantially as described.

12. In a tire-making machine, the combination of a revoluble tire-core, a pair of fabric-applying members adapted to act simultaneously on opposite sides of the core, means common to both of said members to exert the same uniform pressure toward the core on both of said members at all positions of the latter on the core, means to feed said members inwardly toward the core axis, whereby the members act progressively on successive portions of the tire-fabric to apply the same to the core or a previously applied underlying ply of fabric on the core, and manual means to modify equally the action of said pressure-applying means on both of said members, substantially as described.

13. In a tire-machine, the combination of a revoluble tire-core, a carriage, a pair of arms fulcrumed on said carriage, a fabric-applying member on each of said arms, means acting on said arms tending to move said members toward the core during the entire application of the fabric, means to advance said carriage and members toward the core axis, whereby the members may act on successive portions of the tire-fabric to apply the same to the core or a previously applied underlying ply of fabric on the core, and manually-operable means to rock said arms on their fulcrums, whereby to modify the action of said arm-moving means, substantially as described.

14. In a tire-machine, the combination of a revoluble tire-core, a carriage, a pair of arms fulcrumed on said carriage, a fabric-applying member on each of said arms, a weight acting on and common to both of said arms tending to draw said arms toward the core, means to advance said carriage and members toward the core-axis, whereby the members may act on successive portions of the tire-fabric to apply the same to the core or a previously applied underlying ply of fabric on the core, and manually-operable means adapted to rock said arms on their fulcrums, whereby to modify the action of said weight on said arms, substantially as described.

15. In a tire-machine, the combination of a revoluble tire-core, a carriage, a pair of arms fulcrumed on said carriage, a fabric-applying roller mounted on each of said arms, said rollers being adapted to act simultaneously on opposite sides of the core, means acting on said arms tending to press or force said rollers toward the core, means to advance said carriage and rollers toward the axis of the core, whereby the rollers act on successive portions of the tire-fabric to apply the same to the core or a previously applied underlying ply of fabric on the core, a right-angle manually-operable lever connected to one of said arms, and a link connecting said lever to the other arm, whereby the operator is enabled to swing said arms on their fulcrums to modify the action of said arm-pressing means, substantially as described.

16. In a tire-machine, the combination of a revoluble tire-core, a carriage, a pair of arms fulcrumed on said carriage, a fabric-applying member on each of said arms, said members being adapted to act simultaneously on both sides of the core, a weight common to and acting on said arms tending to press or force the members toward the core, and manually-controlled means adapted to advance said carriage and members toward the axis of the core at any one of a plurality of speeds, whereby the members act progressively on opposite sides of the core on successive portions of the tire-fabric to apply the same to the core or a previously applied underlying ply of fabric on the core, the rate of advance of said carriage being determined in accordance with the contour of the surface to which the ply is being applied, substantially as described.

17. In a tire-machine, the combination of a revoluble tire-core, a carriage movable toward and away from the core, means to move said carriage, means mounted on said carriage and adapted to stretch the fabric as it is applied to the core, a second carriage mounted on said first-named carriage, a pair of fabric-applying members mounted on said second carriage and adapted to act simultaneously on opposite sides of the core, and means to advance said second carriage on the first carriage and members toward the axis of the core, whereby said members act on successive portions of the tire-fabric to apply the same to the core or a previously applied underlying ply of fabric on the core, substantially as described.

18. In a tire-machine, the combination of

a revoluble tire-core, a carriage, means to actuate said carriage, means mounted on said carriage and adapted to stretch the ply of fabric as it is applied to the core, including a member adapted to travel on the surface of the core or plies already applied thereto, a second carriage mounted on said first-named carriage, a pair of rollers on said second carriage positioned to act simultaneously on opposite sides of the core, means yieldingly pressing said rollers toward the core, and means to advance said second carriage on the first carriage and rollers toward the axis of the core whereby such rollers act on successive portions of the tire-fabric to apply the same to the core or a previously applied underlying ply of fabric on the core, substantially as described.

19. In a tire-machine, the combination of a revoluble tire-core, a carriage, a checking-roller mounted on said carriage and adapted to frictionally engage the surface of the core or fabric plies thereon, a stretching-roller about which the ply of fabric passes to the core, gearing between said stretching and checking-rollers, a second carriage mounted on said first-named carriage, a pair of fabric-applying rollers mounted on said second carriage, means yieldingly pressing said fabric-applying rollers toward the core, said rollers being adapted to act simultaneously on opposite sides of the core, and means to advance said second carriage toward the core to permit said rollers to act progressively on successive portions of the tire-fabric to apply the same to the core or previously applied underlying plies of fabric on the core, substantially as described.

20. In a tire-machine, the combination of a revoluble tire-core, a carriage, a spring-pressed mounting on said carriage, a checking-roller in said mounting adapted to bear against the surface of the core or applied plies thereon, a stretching-roller in said mounting with which the strip of fabric as it is applied to the core co-acts, gearing between said checking and stretching-rollers whereby the latter has a definite movement with respect to the surface on which the checking-roller travels, a second carriage mounted on said first-named carriage, a pair of fabric-applying rollers mounted thereon adapted to act simultaneously on opposite sides of the core, means yieldingly pressing said rollers toward the core, and means to advance said second carriage on the first carriage and its rollers toward the axis of the core at different speeds of travel whereby the rollers act progressively on successive portions of the tire-fabric to apply the same to the core or previously applied underlying plies of fabric on the core, the different speeds of advance of said second carriage and rollers being employed for applying the fabric on different portions of the core and determined by the contour of the surface to which the ply is being applied, substantially as described.

21. In a tire-machine, the combination of a revoluble tire-core, a carriage movable toward the axis of the core, a fabric-applying roller mounted on said carriage and located in a plane oblique to the path of rotation of the core at the point of action of the roller on the core, means to hold the carriage substantially fixedly in position during the application of the fabric on the surface of the tire between the clench and toe of the bead, and means to cause said roller to traverse said surface during such holding of the carriage to apply the fabric thereto, substantially as described.

22. In a tire-machine, the combination of a revoluble tire-core, a fabric-applying roller, a mounting for said roller, a pair of centering-springs on said mounting between which said roller is accommodated, said springs permitting the roller to shift axially in opposite directions from its normal center position to accommodate itself to irregularities of the bead, and means to advance said roller and mounting toward the core axis, whereby the roller may act progressively on successive portions of the tire-fabric to apply the same to the core or previously applied plies, substantially as described.

23. A roller for applying frictioned fabric to a rotating core and smoothing said fabric upon the core, the boundary of the forward working-side or face being rounded off on a curve of short radius and meeting the back-face or side at its outer edge, substantially as described.

24. In a machine of the character described, the combination of a revoluble-core, means to shape a ply of fabric to the core, means for advancing said shaping-means across the core-face including a shaft, a friction drive wheel on the shaft, an actuating shaft adjacent to the friction drive wheel, differential friction rollers actuated by said second-named shaft, and means for forcing either of said rollers against the friction drive wheel, substantially as described.

25. In a machine of the character described, the combination of a revoluble-core, means for shaping a ply of fabric to the core, means for advancing said shaping-means across the core-face including a shaft, a friction drive wheel on the shaft, an actuating shaft adjacent to the friction drive wheel, differential friction rollers actuated by said second-named shaft, means for holding said rollers normally out of contact with said friction drive wheel, and means for forcing either of said rollers against the friction drive wheel, substantially as described.

26. In a machine of the character de-

scribed, the combination of a revoluble-core, means for shaping a ply of fabric to the core, means for advancing said shaping-means across the core-face including a shaft, a friction drive wheel on the shaft, an actuating shaft adjacent to the friction drive wheel, an eccentric bearing for said actuating shaft equipped with an arm and a handle, a friction drive roller on said shaft, a friction drive roller of different size on said arm, and means to drive said latter roller from said actuating shaft, whereby rocking of the eccentric bearing will bring either one of said rollers into driving contact with the friction drive wheel, substantially as described.

27. In a machine of the character described, the combination of a revoluble core, means for shaping a ply of fabric to the core, means for advancing said shaping-means across the core-face including a shaft, a friction drive wheel on said shaft, an actuating shaft adjacent to the friction drive wheel, an eccentric bearing for said actuating-shaft equipped with a handle and an arm, a friction drive roller on said actuating shaft, a second friction drive roller of different size on said arm, means to operate said second roller from said actuating shaft, and means yieldingly holding said eccentric bearing in neutral position with neither of the rollers in contact with the drive-wheel, the parts being so related that by turning the eccentric bearing by its handle either of said rollers may be brought into operative relation to said drive wheel, substantially as described.

28. In a tire machine, the combination of a core, means for rotating the core, a support, a stitcher on the support, power driven mechanism to cause said stitcher to traverse the side of the core and change speed mechanism in said power mechanism.

29. In a tire machine, the combination of a core, means for rotating the core, a support, a pivotal mounting on said support, a stitcher carried on said mounting, power driven mechanism to cause said stitcher to traverse the side of the core and change speed mechanism in said power mechanism.

30. In a tire machine, the combination of a core, means for rotating the core, a support, a pivotal mounting on said support, a stitcher carried on said mounting movable to change the degree of angularity with relation to the tangent at the point of contact with the core, power driven means to cause the stitcher to traverse the side of the core, and change speed mechanism in said power means.

31. In a tire machine, the combination of a core, means for rotating the core, a support, a pivotal mounting on said support, a swinging arm mounted on said mounting, a stitcher carried on said arm, the stitcher during part of its operation being in one position of angularity with relation to the core, means for moving said arm about the pivot to cause the stitcher to assume different angularity with respect to the tangent at the point of contact with the core, and means for causing the stitcher to traverse the side of the core.

32. In a tire machine, the combination of a core, and means for rotating the same, a vertical pivotal mounting, an arm movable on said mounting, a stitcher on the end of said arm, a resilient mounting for said stitcher between the pivot and the end of the arm, and means for causing said stitcher to traverse the side of the core.

33. In a tire machine, a core, a support for the core, a stitching roller, means for rotating the core and means for causing the stitcher to traverse the side of the core, a second support, a pivotally mounted arm on the second support, a mounting on said arm for said stitching roller, means for maintaining said arm in one position during a portion of the stitching operation and for moving the arm about its pivot to change the angle of the stitcher roller with the core.

WILLIAM C. STEVENS.

Witnesses:
E. E. Cavenshoff,
E. M. Hahn.

Plaintiff's Exhibit No. 14—Moniteur Belge.

2—390.

UNITED STATES OF AMERICA,

DEPARTMENT OF THE INTERIOR,

UNITED STATES PATENT OFFICE.

To all to whom these presents shall come, Greeting:

THIS IS TO CERTIFY that the annexed is a true copy from the Records of this Office of Pages 4454 and 4457, Issue of August 9, 1908, N. 222, of a Publication entitled:-

MONITEUR BELGE,

JOURNAL OFFICIEL,

STATTSBLAD,

1908.

IN TESTIMONY WHEREOF I have hereunto set my hand and caused the seal of the Patent Office to be affixed at Washington in the District of Columbia, this 29th day of July in the year of our Lord one thousand nine hundred and twenty and of the Independence of the United States of America the one hundred and forty-fifth.

R. H. Whitehead [illegible]

Acting Commissioner of Patents.

MINISTÈRE DE L'INDUSTRIE ET DU TRAVAIL.

DIRECTION DE L'INDUSTRIE.

Liste des brevets dont les annuités, échues pendant le mois de septembre 1907, n'ont pas été acquittées dans le délai légal.

204e PUBLICATION.

Numéro du brevet.	NOMS DES BREVETÉS.	DATE LÉGALE du brevet.	ENREGISTREMENT. Bureau de perception.	Art. du sommier.	NATURE du brevet.	OBJET DU BREVET.
						Province d'Anvers.
19 731	Van Migrode	21 sept. 1906	Anvers	52	Uitv.	Overdrukken van geschrift, teekening, planas, enz.
194489	Warmont	1 —	—	10	Inv.	Transmission pour automobiles.
						Province de Brabant.
165554	Alexander	2 sept. 1901.	Bruxelles.	106485	Inv.	Accepter les chèques.
165591	Aktien Ges. für Schmirgel- und Maschine fabrikation.	16 —	—	106633	—	Raboter les roues coniques.
165590	Id.	16 —	—	106656	—	Raboteuse à double effet.
179711	Aarts	22 — 1904	—	118113	—	Fabrication du coke.
194494	Aubry	7 — 1906	—	129971	—	Guêtres pour chevaux.
194690	Adams	17 —	—	130116	—	Cuvette pour W. C.
194780	Andersen	19 —	—	130141	Imp.	Lampes.
194789	Ahrendt et Cᵉ	20 —	—	130158	Inv.	Étirage.
194798	Ado	20 —	—	130160	—	Papiers.
194884	Ancel et Jungius	24 —	—	130220	—	Bandage élastique.
194826	Antonelli	25 —	—	130228	Imp.	Nettoyage de navires et wagons.
106401	Boehringer C.-F. & Soehne	18 — 1893.	—	98315	—	Composé d'albumine-ferrugineux.
112015	Babcock et Wilcox Limited	28 — 1894.	—	102512	Inv.	Générateur de vapeur.
165650	Beard	19 — 1901.	—	106711	—	Support pour prise de courant.
165826	Brillé	29 —	—	106804	—	Baignoire.
172529	Bonnet	24 — 1903.	—	112109	—	Mélanger les liquides.
172740	Behr	23 —	—	112284	—	Fermeture pour cartouche.
179399	Blackett	8 — 1904.	—	118058	Imp.	Perforatrices de rochers.
179400	Id.	8 —	—	118059	—	Percer la roche.
179674	Brownlow	26 —	—	118230	Inv.	Galons pour fermer les rideaux, etc.
179744	Bosch	30 —	—	118290	—	Destruction d'insectes.
186634	Brooks et Watson	1 — 1905	—	125793	Imp.	Appareil à photographier.
186738	Billotti	11 —	—	125846	Inv.	Brûleur pour four continu thermique.
186843	Buder	14 —	—	125917	—	Nettoyage par le vide.
186845	Id.	14 —	—	125918	—	Nettoyer les tapis.
186811	Bouvier	14 —	—	125930	—	Armature pour produits céramiques.
186888	Boriol	16 —	—	125981	—	Semelle en bois.
186951	Brandès et Appelberg	20 —	—	126057	—	Production d'énergie.
187081	Baldwin	23 —	—	126078	—	Verre armé.
187082	Id.	23 —	—	126079	—	Fabrication du verre armé.
194401	Brenizer	1 — 1906.	—	129886	—	Détente pour fusils.
194390	Burlart	1 —	—	129890	—	Moteur.
194405	Berthon	1 —	—	129896	—	Boutons à ressort.
194465	Bardin née Rault	5 —	—	129948	—	[illegible]
194469	Bailey	6 —	—	129963	—	Joint.
194545	Bonet-Duran	8 —	—	129993	—	Pneus.
194571	Bolle et Cᵉ, G. m. b. H.	10 —	—	130004	—	Sels pharmaceutiques.
194570	Buria	10 —	—	130005	—	Aéroplane.
194596	Blondeau	12 —	—	130034	—	Roulement à billes.
194627	Bretmacker	13 —	—	130046	—	Bouchon.
194615	Backbach	13 —	—	130042	—	Fermer les extrémités de bouchons de cigares.
194638	Bonavita	13 —	—	130058	—	Pellicule continue.
194669	Breiller et Marjus	15 —	—	130035	—	Pompe.

NUMÉRO du brevet.	NOMS DES BREVETÉS.	DATE LÉGALE du brevet.	ENREGISTREMENT. Bureau de perception.	Art. du sommier.	NATURE du brevet.	OBJET DU BREVET.
194436	Koepff	4 sept. 1906.	Bruxelles.	129951	Inv.	Sécher la gélatine.
194473	Id.	6 —	—	129969	—	Transporter la gélatine.
194492	Killen	7 —	—	129981	Imp.	Gonfler les pneus.
194509	Kuppenheim	10 —	—	130006	Inv.	Assemblement de pièces précieuses.
194649	Konstruktionsburo Zwickau Seyboth Baumann et C.	14 —	—	130071	—	Soupape de rupture.
194695	Koch	18 —	—	130123	—	Emballage.
194875	Klotz et Raumont	28 —	—	130265	—	Suspension pour véhicules.
111855	Lyon	17 — 1894.	—	62425	—	Harpe.
158596	Luttke	7 — 1901.	—	101035	—	Émulsions pour papiers au chlorure d'argent.
158613	Lindauer	9 —	—	101063	—	Corset.
165343	Liet	1 — 1902.	—	106166	—	Pot à échappement.
165344	Id.	1 —	—	106167	—	Démarrage.
165370	Losange	4 —	—	106306	—	Chauffage de l'eau.
165601	Lewicki	17 —	—	106681	—	Revivification de matières filtrantes.
172398	Libert	7 — 1903.	—	112129	—	Joint.
179280	Leupold	2 — 1904.	—	117950	—	Cruchon de chauffage.
186882	Labre	15 — 1905.	—	123968	—	Réparation de pneus.
186880	Lebrun	16 —	—	123978	—	Application de la méthode des disques rotatifs à la technique microscopique.
187097	Langer	28 —	—	124152	Imp.	Admission dans les foyers fumivores.
194398	Lajoie	1 — 1906.	—	129861	Inv.	Filtre.
194435	Leyman	4 —	—	129928	—	Plateau de lapidaire.
194461	Lainé	5 —	—	129937	—	Abat-jour.
194458	Lévy	5 —	—	129957	—	Tente de plage.
194481	Id.	5 —	—	129958	—	Voiture pliante.
194671	Loeven et Pieper	6 —	—	129968	—	Brosse.
194699	Loewy et Schilton	18 —	—	130128	—	Fenêtre.
194800	Lanneau	24 —	—	130193	—	Arrêt pour poulie.
194806	Lesne	24 —	—	130201	Imp.	Aéroplane.
194862	Lesparre et Beguin	27 —	—	130257	Inv.	Bouchon.
194860	Lannoy et Cᵒ	27 —	—	130261	—	Burette.
158723	Mathieu et Lovekin	14 — 1901.	—	101145	—	Former des brides aux tubes métalliques.
158721	Id.	14 —	—	101146	—	Id.
158914	Mathieu	27 —	—	101291	—	Roulements à billes.
165359	Moore	2 — 1902.	—	106483	—	Fendre les peaux.
165497	Maschinenfabrik und Mühlenbauanstalt G. Luther A. G.	9 —	—	106579	—	Support pour crible.
165736	Mackenzie	23 —	—	106772	Imp.	Cuire les gaufres.
165748	Malche	24 —	—	106784	Inv.	Surchauffeur.
172402	Moen	7 — 1905.	—	112056	—	Distributeur pour moteurs à gaz.
172750	Mangold	26 —	—	112299	—	Boîtes à côtés repliables.
179339	Magnin	7 — 1904.	—	117994	Imp.	Rafraîchir les appartements.
179529	Michaud	17 —	—	118131	Inv.	Pompe.
179606	Marconi's Wireless Telegraph Company Limited.	24 —	—	118229	—	Transmetteur télégraphique.
186635	Muncke	2 — 1905.	—	123792	—	Remplir des récipients de substances plastiques.
186649	Morrell	4 —	—	123816	—	Carburateur.
186750	Mochel	8 —	—	123867	—	Fixer les fourches des vélos.
186777	Maschinenfabrik Georgswerk, G. m. b. H.	9 —	—	123885	Imp.	Lier les gerbes.
186800	Melaun	11 —	—	123897	Inv.	Encastrement des rails de tramway.
186837	Mac Bride	13 —	—	123937	—	Biseauter les glaces.
186859	Manighetti	15 —	—	129964	—	Chemin de fer portatif.
186885	Mirkevitch	16 —	—	129989	—	Traitement de métaux.
186913	Mc Arthur	18 —	—	124001	Imp.	Réflecteur.
186906	Maes et Drape	18 —	—	124005	Inv.	Arrêt pour chaîne.
186941	Mann	20 —	—	124026	Imp.	Tube à mèche.
186934	Mathis	20 —	—	124035	Inv.	Remplaçant d'asphalte.
186954	Meyer et Meunier	21 —	—	124054	Imp.	Attache-cravate.
187008	Moore	22 —	—	124062	Inv.	Chasse à siphons pour w. c.
194552	Maggini	8 — 1906.	—	129998	—	Suspendre les feuilles de tabac.
194505	Marche	12 —	—	130059	—	Tubes.
194707	Maier et Remshardt	18 —	—	130135	—	Moteur.
194731	Mathieu	20 —	—	130161	—	Fabriquer les pneus.
194781	Marie	22 —	—	130182	—	Roue élastique.
194802	Marionnaud	24 —	—	130200	—	Frein.
194821	Martin	24 —	—	130217	—	Jante.
194853	Mousset et Thiriart	26 —	—	130252	—	Coupe-papier.
194873	Neckarsulmer Fahrradwerke A. G.	28 —	—	130268	—	Moyeu frein.
194484	Neumann	7 —	—	129977	—	Réglage de moteurs.
158847	Oswald et Bowman	23 — 1901.	—	101249	—	Production du gaz.
179313	Olsen et Grates	16 — 1904.	—	118117	—	Éteindre et rallumer les becs de gaz.
186630	Oliver	7 — 1905.	—	123852	—	Lampe à arc.
115047	Pfister, Paetz et Lewin	19 — 1899.	—	90012	—	Teinture du bois.
145148	Pilsson	23 —	—	90101	Imp.	Bol à barbe.

Plaintiff's Exhibit No. 16—Plaintiff's Forms of License Agreement since January, 1919.

Within the 6th Circuit.

SUPPLEMENTAL AGREEMENT.

WHEREAS, FRANK A. SEIBERLING, of Akron, Ohio, hereinafter referred to as the Lessor, and.............. ...., of.................., a corporation of the State of..............., hereinafter referred to as the Lessee, have been and now are under a lease agreement in respect to Pneumatic-Tire-Shoe Manufacturing Machines, which are the property of said Lessor and in use by said Lessee;

AND WHEREAS, United States Letters Patent No. 941,962, of November 30, 1909, hereinafter referred to as the State patent, covering certain improvements in Pneumatic-Tire-Shoe Manufacturing Machine, embodied in the leased machines hereinbefore referred to, has been declared partially invalid in a decision rendered December 13, 1918, on which judgment was entered February 14, 1919, by the United States Circuit Court of Appeals for the Sixth Circuit in the suit of The Firestone Tire & Rubber Company, defendant and appellant, against Frank A. Seiberling, plaintiff and appellee; and the Lessor states that it is his purpose to litigate the State patent in another circuit or circuits, and if possible and necessary in the Supreme Court of the United States, with the idea of obtaining the revalidation of such claims, for example, in the suit now pending in the third circuit against John E. Thropp's Sons Company, of Trenton, New Jersey;

AND WHEREAS the Lessor, in view of said decision, has proposed to said Lessee either of the following alternative arrangements; first, to accept the immediate return of the aforesaid leased machines, with termination of said lease agreement under its own provisions, or, second, to continue said lease agreement with the certain modified

terms which are hereinbelow set forth and agreed to in full; and the Lessee has elected to accept and agreed to the second of such proposed arrangements:

Now, THEREFORE, in consideration of the premises and of the modified terms hereinbelow mutually agreed to and of One Dollar by each party unto the other paid, receipt of which is hereby acknowledged, the said Lessor and Lessee have agreed and do hereby formally covenant and agree as follows:

(1) It is hereby agreed that the Lessee is to have the right to retain the leased machines referred to or covered by said lease agreement, and may continue to operate the same.

(2) It is further agreed that the Lessee will keep accurate account of the rentals accruing through its use of the machines, in the manner provided for in said lease agreement, and will continue to report the full amount of these accruing rentals to the Lessor monthly, as heretofore.

(3) It is further agreed that the Lessee will pay to the Lessor for each month commencing January 1, 1919 an amount equal to one-half of such accrued and reported rentals; and that the Lessee may retain the remaining half of such rentals for the present.

(4) If the Circuit Court of Appeals for the Third Circuit fails to revalidate substantial claims of the State patent, it is further agreed that further payment by the Lessee to the Lessor of rentals shall be discontinued and the machine shall become the property of the Lessee without further consideration.

(5) If, however, the Circuit Court of Appeals for the Third Circuit does revalidate substantial claims of the State patent, it is agreed that the Lessee shall continue paying the Lessor one-half of the accruing rentals as provided in Clause (3) above, pending such review as the Supreme Court of the United States may grant upon any application for writ of *certiorari* or otherwise.

(6) If the Supreme Court of the United States thereafter revalidates substantial claims of the State patent, it is agreed that thereupon the Lessee shall immediately pay to the Lessor all the retained rentals provided in Clause (3), with interest at 6% per annum, and that the lease agreement is thereupon to be reinstated automatically in all its original terms.

(7) If, however, the Supreme Court of the United States fails to revalidate substantial claims of the State patent, it is agreed that the lease agreement shall thereupon automatically become null and void, and that the machines shall become the property of the Lessee without further consideration and without further rental payments; and it is understood that the steps and procedure intended to secure such review by the Supreme Court shall be taken by the Lessor with all reasonable diligence.

IN WITNESS WHEREOF the parties have hereunto affixed their signatures and seals this......day of........1919.

....
Lessor

Witnesses:

....

....

....
Lessee

Attest:

....
Secretary

By..........................
President

Outside of the 6th Circuit.

SUPPLEMENTAL AGREEMENT

WHEREAS, FRANK A. SEIBERLING, of Akron, Ohio, hereinafter referred to as the Lessor, and the .... of ...., a corporation of the state of ...., hereinafter referred to as the Lessee, have been and now are under a lease agreement in respect to Pneumatic-Tire-Shoe Manufacturing Machines, which are the property of said Lessor and in use by said Lessee;

AND WHEREAS, United States Letters Patent No. 941,962, of November 30, 1909, hereinafter referred to as the State patent, covering certain improvements in Pneumatic-Tire-Shoe Manufacturing Machines, embodied in the leased machines hereinbefore referred to, has been declared partially invalid in a decision rendered December 13, 1918, on which judgment was entered February 14, 1919, by the United States Circuit Court of Appeals for the Sixth Circuit in the suit of The Firestone Tire & Rubber Company, defendant and appellant, against Frank A. Seiberling, plaintiff and appellee; and the Lessor states that it is his purpose to litigate the State patent in another circuit or circuits, and if possible and necessary in the Supreme Court of the United States, with the idea of obtaining the revalidation of such claims, for example, in the suit now pending in the third circuit against John E. Thropp's Sons Company, of Trenton, New Jersey;

AND WHEREAS, the Lessor, in view of said decision, has proposed to said Lessee either of the following alternative arrangements; first, to accept the immediate return of the aforesaid leased machines, with termination of said lease agreement under its own provisions, or, second, to continue said lease agreement with the certain modified terms which are hereinbelow set forth and agreed to in

full; and the Lessee has elected to accept and agreed to the second of such proposed arrangements:

NOW, THEREFORE, in consideration of the premises and of the modified terms hereinbelow mutually agreed to and of One Dollar by each party unto the other paid, receipt of which is hereby acknowledged, the said Lessor and Lessee have agreed and do hereby formally covenant and agree as follows:

(1) It is hereby agreed that the Lessee is to have the right to retain the leased machines referred to or covered by said lease agreement, and may continue to operate the same.

(2) It is further agreed that the Lessee will keep accurate account of the rentals accruing through its use of the machines, in the manner provided for in said lease agreement, and will continue to report the full amount of these accruing rentals to the Lessor monthly, as heretofore.

(3) It is further agreed that the Lessee will pay to the Lessor for each month commencing January 1, 1919 an amount equal to one-half of such accrued and reported rentals; and that the Lessee may retain the remaining half of such rentals for the present.

(4) In case the Circuit Court of Appeals for the Third Circuit denies the validity of all substantial claims of the State patent, it is agreed that all further payments of rentals by the Lessee may be discontinued, and that the leased machines shall become the property of the Lessee without further consideration.

(5) If, however, the Circuit Court of Appeals for the Third Circuit revalidates substantial claims of the State patent, it is hereby further agreed that upon the rendering of such decision, the Lessee will pay to the Lessor with interest at 6% per annum the accrued amount representing the withheld one-half of the rentals referred to in Clause (3) above, and that the lease agreement is then

to be forthwith reinstated automatically in all its original terms.

(6) If, thereafter, however, the Supreme Court of the United States should ultimately invalidate all substantial claims of the State patent, it is further agreed that the lease agreement shall then automatically become null and void, and the leased machines become the property of the Lessee without further consideration and without further rental payments.

IN WITNESS WHEREOF the parties have hereunto affixed their signatures and seals this .... day of ...., 19...

....
Lessor

Witnesses:

....

....

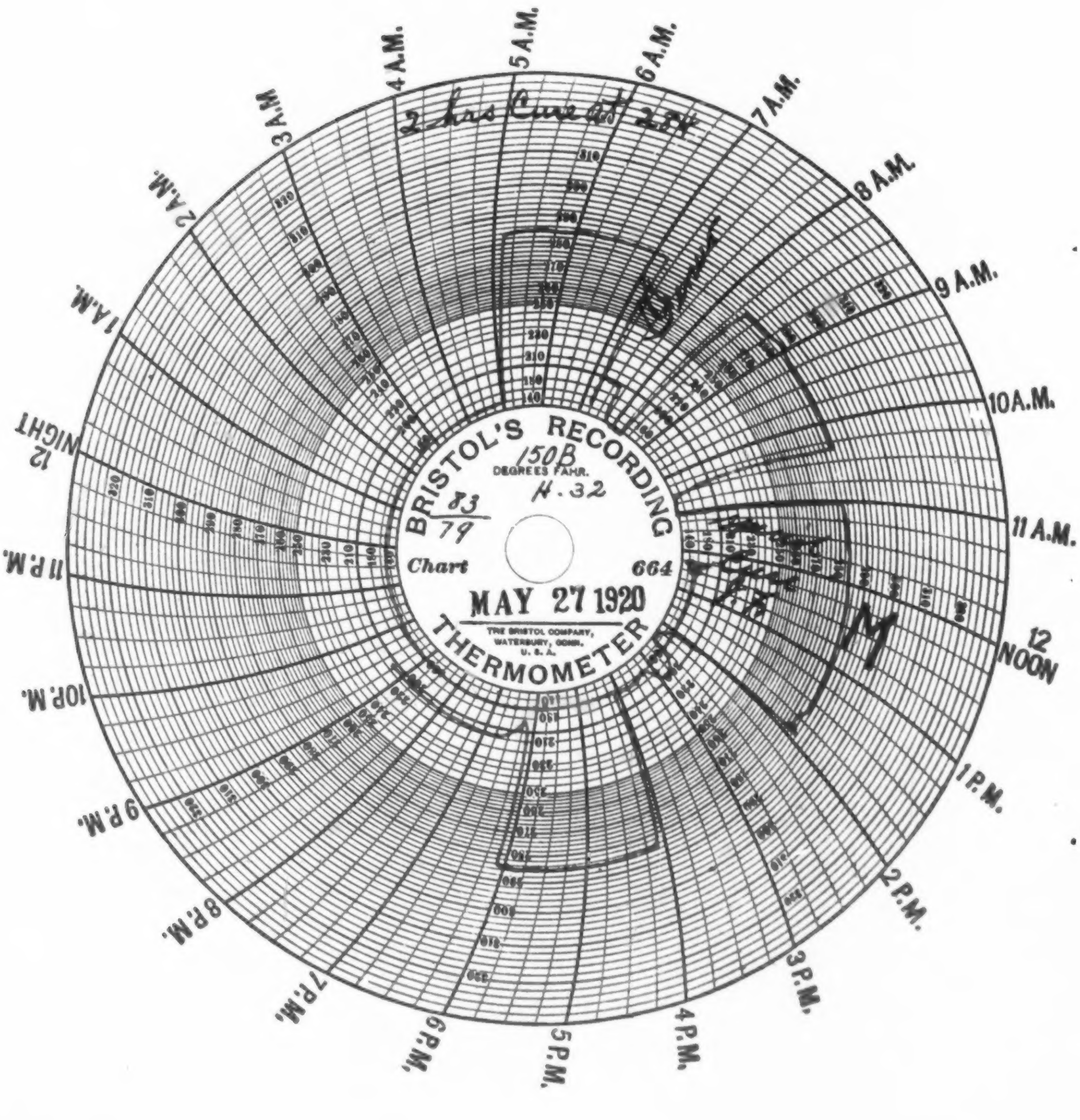
....
Lessee

By ....
President

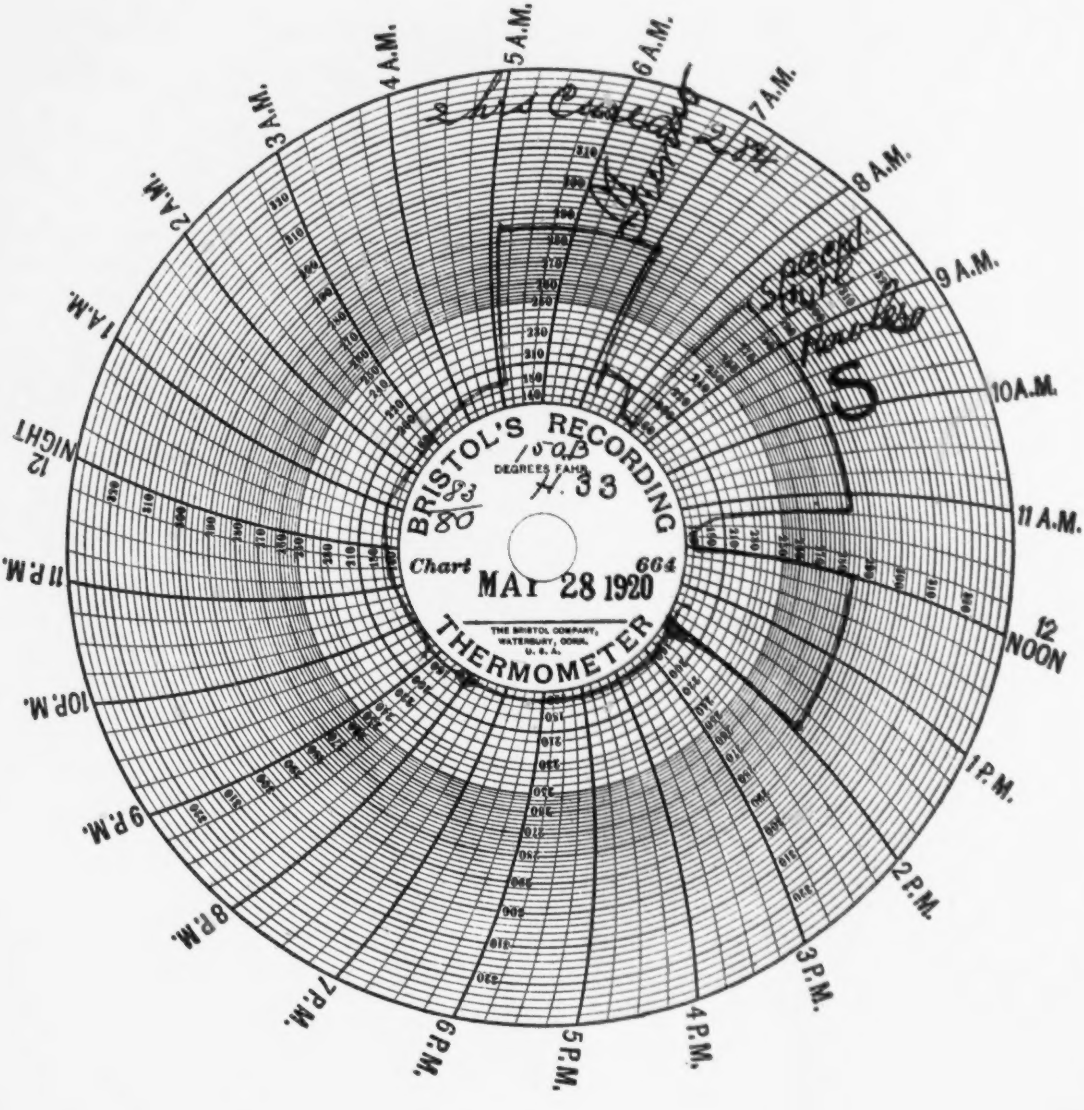
Attest:

....
Secretary

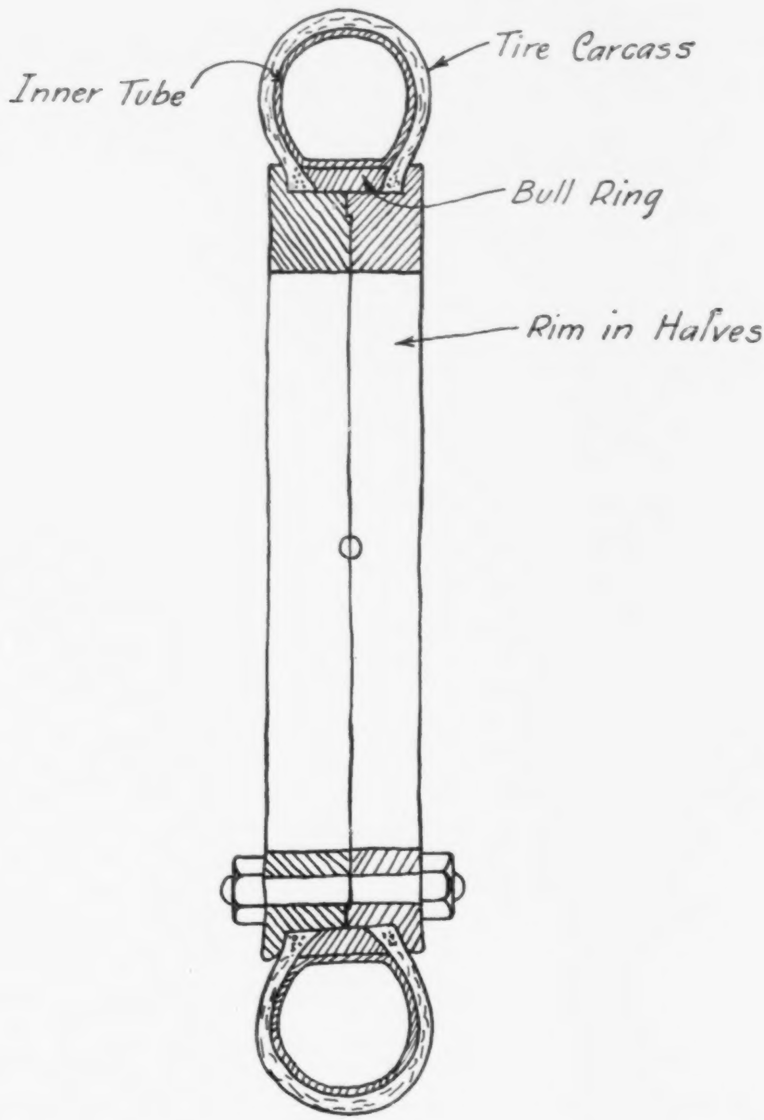
Plaintiff's Exhibit No. 17—Vulcanizing Charts.
(Mackey Tires.)



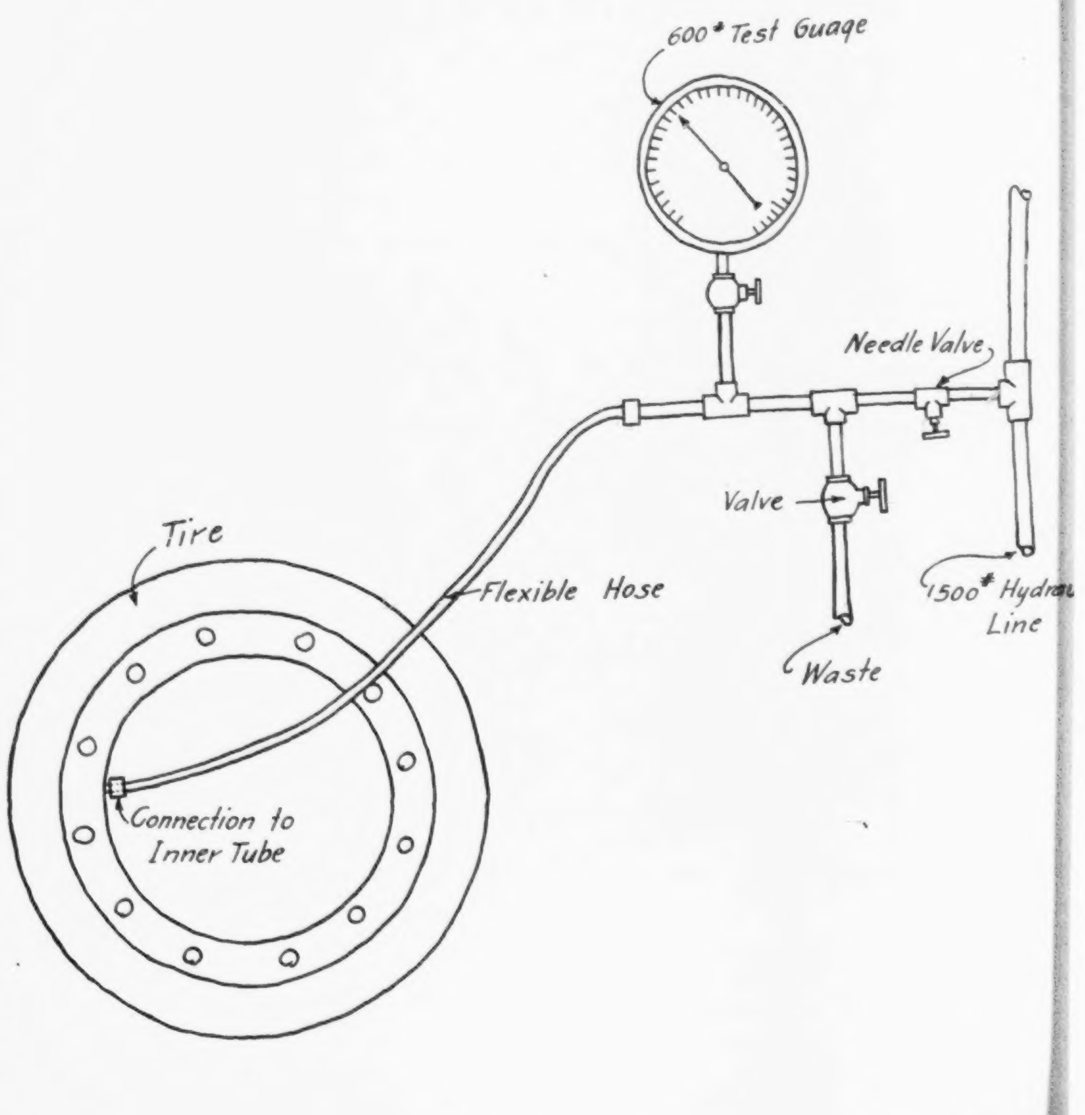
Plaintiff's Exhibit No. 17—Vulcanizing Charts.
(Shaw Tires.)



Plaintiff's Exhibit No. 20—Ray Holding Device.



Plaintiff's Exhibit No. 21—Ray Bursting Apparatus.



Plaintiff's Exhibit No. 22—Pages 163 and 164, American Machinist Gear Book.

(Page 163.)

SECTION VI

Worm Gears

An interesting model of half a dozen sets of worm gears is shown in Fig. 109. All the gears are of the same diameter with teeth of the same normal pitch, though the respective speed ratios of the various sets differ. The horizontal shaft in making 32 revolutions causes the vertical gear in the fore-

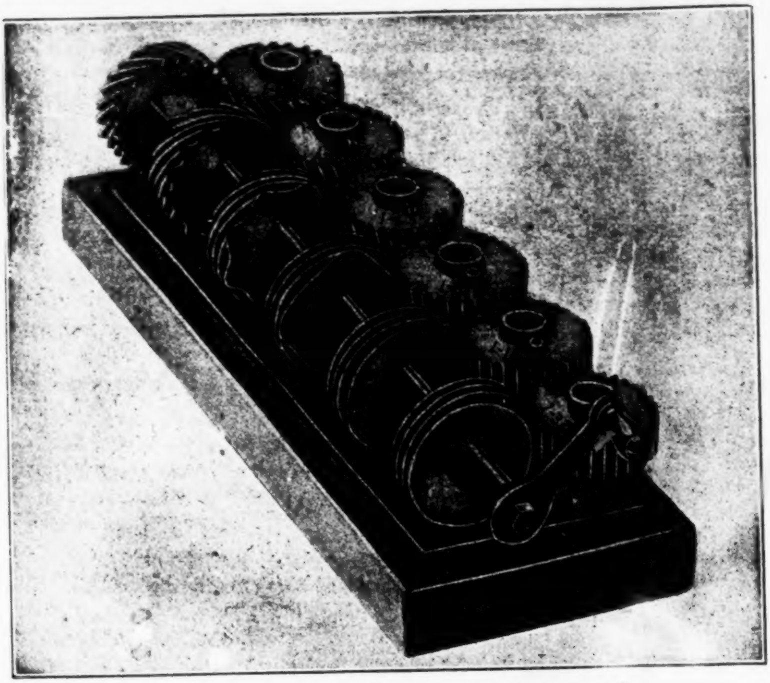


FIG. 109. MODEL OF SPIRAL GEARS OF VARIOUS RATIOS.

ground to make but one complete revolution, the second, two complete turns, and each of the succeeding vertical gears twice the number of revolutions made by the gear immediately in front of it, the furthermost gear making 32

Plaintiff's Exhibit No. 22—Pages 163 and 164, American Machinist Gear Book.

(Page 164.)

revolutions to 32 turns of the horizontal shaft. The consecutive speed ratios, commencing with the set in the foreground, are respectively 32:1, 16:1, 8:1, 4:1, 2:1 and 1:1, the revolutions of the horizontal shaft being named first.

The first three drives are evidently worms of single, double and quadruple thread respectively, but they are also spiral gears as the driven gears are cut with spiral teeth, not simply hobbed as is customary in laying out worm gears. The balance of the drivers resemble spiral gears even more, particularly the most remote, showing that the so-called "worm" is in reality a toothed gear of the spiral type.

NOTATION FOR WORM GEARS

N = number of teeth in worm wheel.
n = number of threads in worm.
p' = circular pitch (distance from center to center of teeth).
L = lead (advance of worm in one revolution).
D' = pitch diameter of worm wheel.
T = throat diameter of worm wheel.
D = outside diameter of worm wheel.
F = face of worm wheel.
a = distance from center line to point of tooth.
b = length of side.
d' = pitch diameter of worm.
d = outside diameter of worm.
d'' = bottom diameter of worm.
e = radius at throat of worm wheel.
ϕ = angle of sides of face.
B = center distance.
R = number of revolutions of worm to one of wheel.
δ = angle of teeth in wheel with axis (used for gashing teeth).
π = 3.1416.
W = working depth.
W' = whole depth.
f = clearance.
t = thickness of tooth at pitch line.
t^n = normal thickness of tooth at pitch line.
p'^n = normal circular pitch.
s = addendum.
U = width of worm thread at top.
Y = width of worm thread at bottom.
p = diametral pitch.

Plaintiff's Exhibit No. 23—Pages 102, 106, 107, The Theory of Machines.

(Page 102.)

same in each gear. Calling the normal pitch p, then for both gears $p = p_1 \cos \theta_1 = p_2 \cos \theta_2 = 1.256 \cos 26° 34' = 1.123$ in.

For the gear G the number of teeth $t_2 = 40$ since $n_1 = 2n_2$ and $p_1 = 2.513$ in. while $p = 1.123$ in. A sketch of the gear F is given at Fig. 62.

117. Form of Teeth.—Much discussion has arisen over the correct form of the teeth on such gears, and indeed it is almost impossible to make a tooth which will be theoretically correct, but here again one is to be guided by the fact the correct conditions must be fulfilled in the plane normal to the line of contact. Hence on this normal plane the teeth should have the correct involute or cycloidal profile.

In this type of gearing there is a good deal of slip along the line of contact (CQ) resulting in considerable frictional loss and wear, but such gearing, if well made will run very smoothly and quietly. Although it is difficult to construct there are cases where the positions of the shafts make its use imperative.

SPIRAL OR SCREW GEARING

The Teeth of which have Point Contact

118. Screw Gearing.—In speaking of gears for shafts which were not parallel and did not interest two classes were mentioned: (a) hyperboloidal gears, and (b) spiral or screw gears and this latter class will now be discussed, the former having just been dealt with. In screw gearing there is no necessary relation between the diameters of the wheels and the velocity ratio n_1/n_2 between the shafts; thus it is frequently found that while the camshaft of a gas engine runs at half the speed of the crankshaft, the two screw gears producing the drive are of the same diameters, while if skew level gears were used the ratio of diameters would be 1 to 4 (Sec. 114(d)) and bevel and spur gears for the same work would have a ratio 1 to 2.

119. Worm Gearing.—The most familiar form of this gearing is the well-known worm and worm wheel which is sketched in Fig. 63, and it is to be noticed that the one wheel takes the form of a screw, this wheel being distinguished by the name of the **worm.** The distance which any point on the pitch circle of the worm wheel is moved by one revolution of the worm is called the axial pitch of the worm, and if this pitch corresponds to the distance from thread to thread along the worm parallel to its

Plaintiff's Exhibit No. 23—Pages 102, 106, 107, The Theory of Machines.

(Page 106.)

tion of the worm thread is shown at Fig. 66 in which the proportions used by Brown and Sharpe are the same as in a rack

123. Large Ratio in this Gearing.—Although the frictional losses in screw gearing are large, even when the worm works immersed in oil, yet there are great advantages in being able to obtain high velocity ratios without excessively large wheels. Thus if a worm wheel has 40 teeth, and is geared with a single-threaded worm, the velocity ratio will be $\frac{1}{40}$, while with a double-threaded worm it will be $\frac{2}{40} = \frac{1}{20}$, so that it is very convenient for large ratios. It also finds favor because ordinarily it cannot be reversed, that is, the worm must always be used as the driver and cannot be driven by the wheel unless the angle θ is large. In cream separators, the wheel is made to drive the worm.

124. Screw Gearing.—Consider now the case of the worm and wheel shown in Fig. 65, in which both are cylinders, and suppose that with a worm of given size a change is made from a single to double thread, at the same time keeping the threads of the same size. The result will be that there will be an increase in the angle θ and hence the threads will run around the worm and the teeth will run across the wheel at greater angle than before. If the pitch be further increased there is a further increase in θ and this may be made as great as 45°, or even greater, and if at the same time the axial length of the worm be somewhat decreased, the threads will not run around the worm completely, but will run off the ends just in the same way as the teeth of wheels do.

By the method just described the diameter of the worm is unaltered, and yet the velocity ratio is gradually approaching unity, since the pitch is increasing, so that keeping to a given diameter of worm and wheel, the velocity ratio may be varied in any way whatever, or the velocity ratio is independent of the diameters of the worm and wheel. When the pitch of the worm is increased and its length made quite short it changes its appearance from what it originally had and takes the form of a gear wheel with teeth running in helices across the face. A photograph of a pair of these wheels used for driving the camshaft of a gas engine is shown in Fig. 67, and in this case the wheels give a velocity ratio of 2 to 1 between two shafts which do not intersect, but have an angle of 90° between planes passing through their axes. This

Plaintiff's Exhibit No. 23—Pages 102, 106, 107, The Theory of Machines.

(Page 107.)

form of gear is very extensively used for such purposes as aforesaid, giving quiet steady running, but, of course, the frictional loss is quite high.

Some of the points mentioned may be made clearer by an illustration. Let it be required to design a pair of gears of this type to drive the camshaft of a gas engine from the crankshaft, the velocity ratio in this case being 1 to 2, and let both gears be of the same diameter, the distance between centers being 12 in. From the data given the pitch diameter of each wheel will be

Fig. 67.—Screw gears.

12 in. and since for one revolution of the camshaft the crankshaft must turn twice, the pitch of the thread on the worm must be $\frac{1}{2} \times \pi \times 12 = 18.85$ in. For the gear on the crankshaft (corresponding to the worm) the "teeth" will run across its face at an angle given by $\tan\theta = \frac{18.85}{\pi \times 12} = 0.5$, or $\theta = 26° 34'$, and this angle is to be measured between the thread or tooth and the plane normal to the axis of rotation of the worm (see Fig. 64). The angle of the teeth of the gear on the camshaft (corresponding to

Plaintiff's Exhibit No. 24—Pages 261 and 262, Pure Mechanism.

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CHAPTER XII

HELICAL GEARS

265. Classification.—The gears which are to be discussed in this chapter have been variously designated by different authors

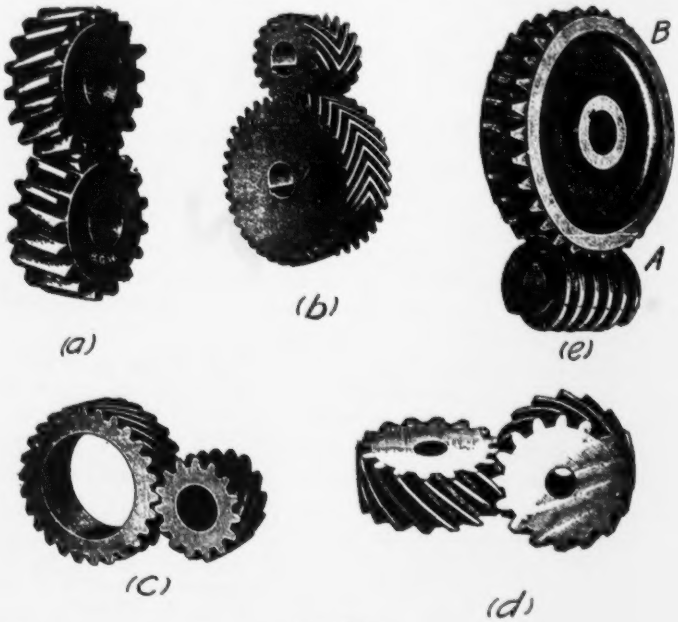

FIG. 254.

as spiral gears, helical gears, screw gears and twisted gears. These names are often confused or used synonymously

The following classification is based on the discussion by Professor MacCord.

Plaintiff's Exhibit No. 24—Pages 261 and 262, Pure Mechanism.

(Page 262.)

Helical or spiral gears	Twisted gears	Single twisted gears, Fig. 254 (*a*). Double twisted or herring-bone gears, Fig. 254 (*b*).
	Screw gears	Worm gears, Fig. 254 (*e*). The type commonly called spiral gears, Figs. 254 (*c*) and (*d*).

The name *spiral gear*, which was used by Hooke to designate the twisted helical gear, is in a sense erroneous. The geometrical spiral, which is a plane curve, does not enter into its construction. *Spiral* is used rather in the loose sense of a "spiral screw thread" or a "spiral staircase." The tooth elements are in fact portions of a helix.

The slope of the helical tooth elements may be either right or left hand. A right-hand tooth, when viewed from the end of the pitch cylinder, slopes upward to the right and a left-hand tooth slopes upward to the left.

The outlines of the teeth, on the plane of reference, are of the involute form as a matter of convenience but not of necessity, any of the tooth forms that are suitable for spur gears can be used for helical gears.

Helical gears are much used when a great change in velocity is required and where noiselessness and smoothness of action at high speeds are of prime importance.

266. Relation of Axes.—The helical angle is the angle made by the tooth helix with a line parallel to the axis of the gear (α, Fig. 255).

Three arrangements of the axes are to be noted:

(1) Axes parallel.

(2) Axes askew.

(3) Axes at right angles.

Fig. 255, (*a*) and (*b*) illustrate the first arrangement. At (*a*) the helical angles are equal and one is a right-hand helix and the other left. This corresponds to the single twisted gear of Fig. 254 (*a*).

At (*b*), each gear has a right- and a left-hand helix which meet on the median planes of the wheels. This is the double twisted, or herringbone gear, shown in Fig. 254 (*b*).

In Fig. 256 (*a*) and (*b*), the axes are askew and the helical angles are unequal. At (*a*), one of the angles is right hand and the other

mold calls for nearly 140 cubic feet of molten iron the stream is soon exhausted. Before the ladle is quite empty the second one has begun to deliver its contents, the principal item of instruction to the man in charge of it being to keep the runner full. This ladle empties apparently nearly as rapidly as the other, and when its contents have nearly all disappeared the spectator indulges in a moment of anxiety as to the sufficiency of the supply of metal; but it begins to flow from the risers just as the ladle is emptied, and the nice calculation as to the quantity required is vindicated.

The weight of this wheel was of course no test of the capacity of the foundry to produce heavy castings. The only visible limit would be in the ability of the railroads to transport the castings after they were made. The cranes in this case handled the entire charge of metal in the two ladles with perfect ease. For still larger castings standing ladles at a sufficient elevation, with gates and suitable leaders to the mold, could of course be employed. The pouring of a larger wheel, or of similar heavy castings, being a familiar and every-day occurrence at this foundry it did not interfere with the routine work going on in other parts of the floor. Not far from the wheel was a large low-pressure cylinder poured two or three days before and not yet fully uncovered. A little further on they were laying up a loam mold of another cylinder. The pouring of castings of various weights for electrical and other service was also going on. The foundry makes both the heaviest and the lightest castings that customers can call for, and anything between. Their advertised range of "from 40 tons to a quarter of an ounce," or 5,120,000 to 1, is easily within their limit. There were on the floor at the west end, as near as I could calculate, and as I was also told, about 9,000 molds of small work, all put up that day and mostly made in snap flasks, and the molders were pouring them with hand ladles. The patterns for this work were in cards, and some were so small as to have three of these cards to a snap flask. I saw one man pour twelve of these molds, with three separate sprues to each, with one ladleful of iron. R.

▲ ▲ ▲

Progress in Gun Making.

On testing the 8-inch Haskell multicharge gun in February last, by the Board of Ordnance and Fortification of the War Department, only two rounds were fired, and at the second round the metal between the forward pocket and the bore was found to have been crushed in; this rendered the gun unserviceable. The Board has declined to make a recommendation for any further expenditure on multicharge guns, believing, as it does, that smokeless powder has in a great measure obviated the necessity for the multicharge gun

The 8-inch Gatling gun provided for by the Act of June 6, 1896, is now under process of construction.

The mill for hot rolling the segments to be used in the manufacture of a 10-inch Brown segmental tube, wire-wound gun, also the machine for winding wire on the gun with the requisite initial tension, are completed, and the wire and steel for the segments have been made. The lining tube is now in course of construction at the works of the Bethlehem Iron Works. It is expected that the gun will be ready for test about July 1, 1898.

The Bethlehem Iron Company is also making excellent progress on its 100 gun contract of recent date, and it is expected that these guns, consisting of twenty-five 8-inch, fifty 10-inch and twenty-five 12-inch guns, will be completed and delivered considerably in advance of the contract time.

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Modern Practice with Worm Gearing.

BY F. A. HALSEY.

Several references have of late appeared in these columns to the fact that, in the face of the good results now being obtained, the old prejudice against worm gearing, on account of its supposed low efficiency and short life, is dying out. These good results are the outcome of the application of principles which are by no means a late discovery, and it is expected that the following article will contain much that to some of the readers of this paper is not new. At the same time it is an undoubted fact that the best practice with worms is understood by but few, relatively speaking, and some of the illustrations to follow are believed to be new. No better illustration of the fact that good practice with worm gearing is not yet widely understood could be given than the statement in a recent and excellent work on gearing that "the diameter of the worm is commonly made equal to four or five times the circular pitch," the fact being that such proportions are distinctly bad if hard work is to be done.

It should be stated at the beginning that while the following article is not offered as a presentation of all the data necessary for assured success with worms under all conditions, it is hoped in it to make the general conditions of successful practice plain, and to present the "state of the art" as it exists to-day.

The essential change in practice which has improved the results obtained with worm gearing has been an increase in the pitch over what was formerly considered proper. There is no doubt whatever that this change has increased the efficiency of the gear, and, what is of more importance, has reduced the tendency to heat and rapid wear. This is not only a fact, but it is a sound conclusion from theoretical considerations, which might have been predicted under proper examination.

THEORY OF WORM EFFICIENCY.

The reason why an increase of pitch, other things being equal, or in other words, an increase of the angle of the thread, gives these results, will be understood from Fig. 1. If a b be the axis of the worm and c d a line representing a thread, against which a tooth of the wheel bears, it will be seen that if the tooth bears upon the thread by a presure, P, that pressure may be resolved into two components, one of which, e f, is perpendicular, while the other, e g, is parallel to the thread surface. The perpendicular

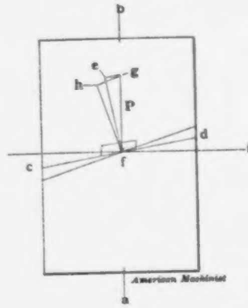

Fig. 1

THE PRINCIPLE OF WORM EFFICIENCY.

component produces friction between the tooth and the thread. The useful work done during a revolution of the thread is the product of the load P and the pitch of the worm, while the work lost in friction is the product of the perpendicular pressure e f, the coefficient of friction and the distance traversed in a revolution, which is the length of one turn of the thread. Now, if the angle of the thread be doubled, as indicated, the load P remaining the same, the new perpendicular component f h of P will be slightly reduced from the old valve e f, while the length of a turn of the thread will be slightly increased. Consequently their product and the lost work of friction per revolution will not be much changed. The useful work per revolution will, however, be doubled, because, the pitch being doubled, the distance traveled by P in one revolution will be doubled. The ratio of the lost work to the useful work is therefore reduced by the increase in the thread angle, and since the tendency to heat and wear is the immediate result of the lost work, it follows that that tendency is reduced. For small angles of thread the change is very rapid ,and continues, though in diminishing degree, until the angle reaches a value not far from 45 degrees, when the conditions change and the lost work increases faster than the useful work, an increase of the angle of the thread beyond that point reducing the efficiency.

This general consideration of the sub-

ject shows the principles at the bottom of successful worm design, but a more exact examination is desirable. According to Professor Barr the efficiency of a worm gear, the friction of the step being neglected, is:

$$e = \frac{\tan a\ (l - f \tan a)}{\tan a + f}$$

in which,

e = efficiency

a = angle of thread being the angle $d\ f\ i$ of Fig. 1

f = coefficient of friction.

To study the effect of the step, a convenient assumption is that the mean friction radius of the step is equal to that of the worm. This asumption would only be realized in cases where the step is a collar bearing outside the worm shaft, and the preceding and following formulas therefore represent extreme cases, one of a frictionless step, which would be approximated by a ball bearing, and the other of a step having about the extreme friction to be met with. Most actual cases would therefore fall between the two. Again, according to Professor Barr, the efficiency of a worm and step on the above assumption is: *

$$e = \frac{\tan a\ (l - f \tan a)}{\tan a + 2f} \text{ approximately}$$

Notation as before.

These formulas give no clear indication of the manner in which the efficiency varies with the angle, and the diagram, Fig. 2, has been constructed to show this to the eye. The scale at the bottom gives the angles of the thread from 0 to 90 degrees, while the vertical scale gives the calculated efficiencies, the values of which have been obtained from the equations and plotted on the diagram. The upper curve is from the first equation, and gives the efficiencies of the worm thread only; while the lower curve, from the second equation, gives the combined efficiency of the worm and step. In the calculation for the diagram it is necessary to assume a value for f, and this has been taken at .05, which is probably a fair mean value. The experiments made by Mr. Wilfred Lewis for Wm. Sellers & Co. showed an increase of efficiency with the speed. The present diagram may be considered as confined to a single speed, and at the same time is not to be understood as showing the exact efficiency to be expected from worms, but rather to exhibit to the eye the general law connecting the angle of the thread with the efficiency.

The curves will be seen to rise to a maximum and then to drop. The exact values of the angle of thread to give maximum efficiency may be easily found by the methods of the calculus, the results being:

For worm thread alone the efficiency is at a maximum when

$$\tan a = \sqrt{l + f^2} - f$$

Substituting the value of f used in calculating the diagram —.05— this becomes

$\tan \times$ per maximum efficiency = .9512,

and by referring to a table of natural tangents we find that,

a for maximum efficiency = 43° 34′

Similarly for the worm and step the result is,

$\tan a$ for maximum efficiency $= \sqrt{2 + 4f^2} - 2f$ which for $f = .05$ $= 1.318$

and a table of tangents tells us again that

a for maximum efficiency = 52° 49′

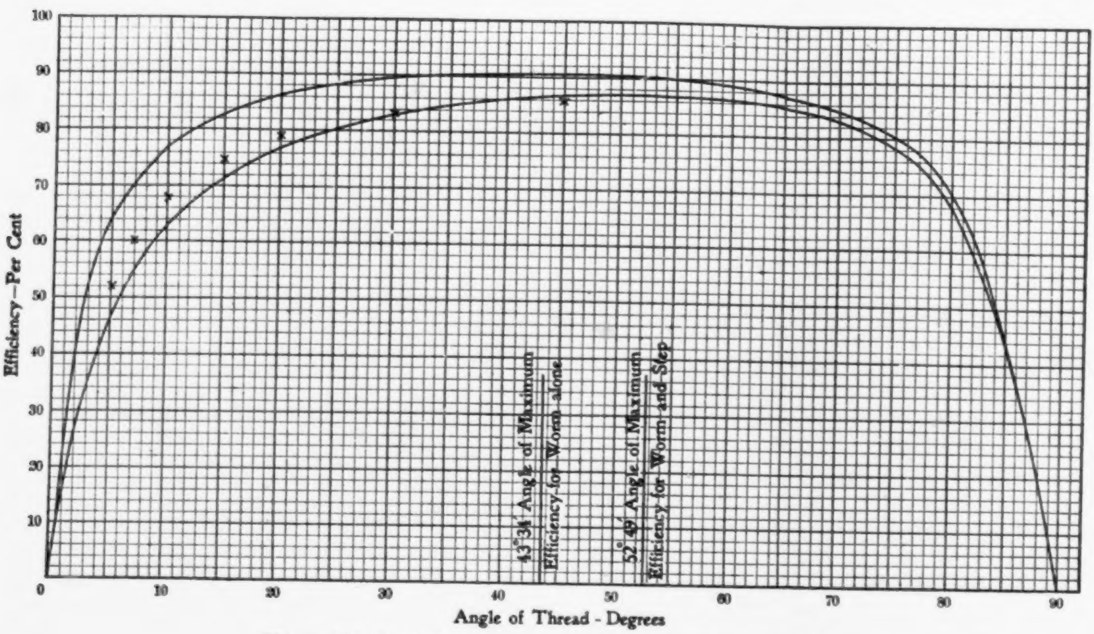

FIG. 2.—RELATION BETWEEN THREAD ANGLE AND EFFICIENCY.

Of more importance than the angle of maximum efficiency is the general character of the curves, of which the most pronounced peculiarity is the extreme flatness, showing that for a wide range of angles the efficiency varies but little. Thus, for the upper curve there is scarcely any choice between 30 and 60 degrees of angle, and but little drop at 20 degrees.

At first sight the lower curve might be thought the most useful of the two, as it includes the effect of the step, but a little consideration will show that this is not the case. For most cases in which worms are used the efficiency of the transmission, as such, is of very little account. What the designer concerns himself with is the question of durability and satisfactory working, and the results to be expected in this respect are best shown by the upper curve, in which high efficiency means a durable worm. Throughout this article, in fact, the chief significance of efficiency

* The derivation of these formulas is somewhat involved and need not be given here. It should, however, be stated that they assume the thread of the worm to be square. Thread profiles in common use affect the results but little.

lies in the fact that low efficiency means rapid wear, and vice versa.

EXPERIMENTAL CORROBORATION OF THE THEORY.

The experiments of Wm. Sellers & Co., before referred to, go far to confirm the soundness of the above views. From the present standpoint it is unfortunate that those experiments did not cover a wider range of worm thread angles—those actually used being 5 degrees, 7 degrees and 10 degrees. Other experiments were, however, made on spiral pinions of higher angles, spiral pinions being understood by Mr. Lewis to mean those pinions having the mating gear a true spur, the pinion shaft being at a suitable angle with the gear shaft to bring the pinion in proper mesh—a construction which is exemplified in the well-known Sellers planer drive. Mr. Lewis gives a formula by which the efficiencies of worms can be calculated from those for spiral pinions, and in the absence of direct experiments on worms of high angles, his results for spiral pinions have been modified by this formula to read for worms. The results for the two forms of gearing differ by less than 5 per cent. for the extreme case of his experiments. To compare the results obtained by Mr. Lewis with Professor Barr's formula, a speed has been selected from the experiments giving the nearest coefficient of friction to that used in obtaining the curves of Fig. 2. The results have been plotted in Fig. 2, where they appear as small crosses, and will be seen to have a very satisfactory agreement with the lower curve, with which they should be compared, as the steps of the worms used by Mr. Lewis were of the usual pattern without balls.

The variation of the coefficient of friction with the speed lends an interest to Fig. 3, which is a series of curves obtained from the results published by Mr. Lewis in the same manner as the crosses of Fig. 2, the curve for 20 feet velocity being in fact the same as that appearing as crosses in Fig. 2. The other curves of Fig. 3 are obtained from those of Mr. Lewis, and cover a range of velocities from 3 to 200 feet per minute at the pitch line, as noted at the right. In this diagram the results obtained by Mr. Lewis on worms are plotted direct, but the experiments on spiral pinions have been modified as explained above. Inspection of the curves shows that while there is a progressive increase of efficiency with the speed, there is, nevertheless, not much probability, or indeed room, for further improvement beyond the speed of 200 feet per minute. It will furthermore be seen that the efficiency drops off much less for low angles of thread at high speeds than at low.

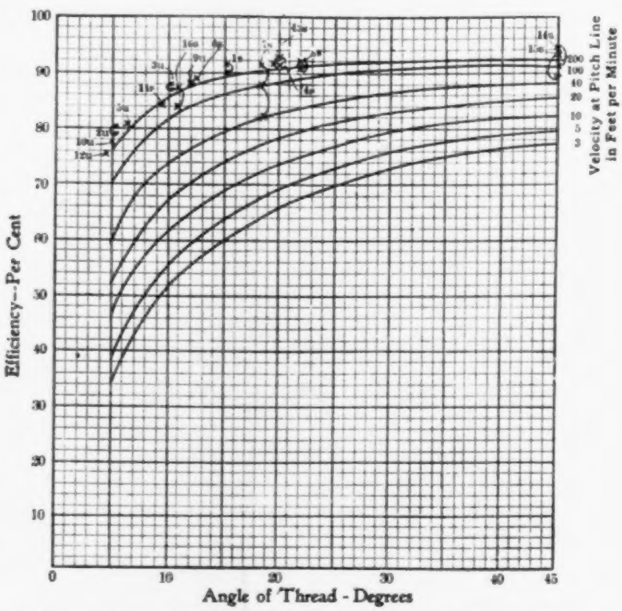

FIG. 3.—RELATION BETWEEN THREAD ANGLE, SPEED AND EFFICIENCY, WITH CASES FROM PRACTICE.

In interpreting this diagram, it should be remembered that the durability of a worm depends upon the amount of power lost in wear, and not upon the percentage so lost. The ability of a given worm to absorb and carry off the heat due to friction is fixed, and does not vary with the speed. That is, a given worm running at 100 revolutions under a given pressure can cary off as much friction heat as the same worm at 200 revolutions, while it, under the same pressure, would transmit but one-half the power in the former case that it would in the latter. In other words, the percentage of lost work might be twice as much at the lower speed as at the higher without increasing the tendency to heat.

The increase of efficiency with the speed is a valuable property of worms, and enables them to do much more work than they otherwise would. Thus the 20 degree worm at 20 feet per minute lost 21½ per cent. of the work in friction. Increasing the speed to 40 feet doubled the work applied, and, had the efficiency remained constant, would have doubled the friction heat to be dissipated. In point of fact, this increase of speed diminished the percentage of loss to 17, and the amount of loss and heat, instead of being doubled, was only increased in the ratio of 160 to 100. It is plain from the diagram, however, that this action does not continue much beyond a velocity of 200 feet per minute, beyond which the amount of loss must be more nearly proportional to the speed, and this doubtless has some connection with the fact observed by Mr. Lewis that 300 feet per minute is the limit of speed when the gears are loaded to their working strength, and that the best conditions are obtained at about 200 feet per minute. It is proper to add, however, that in the cases from practice given later there are three which have been made repeatedly, and which are conspicuously successful, in which the velocity exceeds 600 feet, and one in which it exceeds 800 feet. No doubt, in all such cases, if the pressure on the teeth could be known it would be found to be light.

It will be seen that an increase of speed for any worm under constant pressure leads to an increase of friction work, and the limit is reached when the worm is no longer able to carry off the heat generated fast enough to prevent undue rise in temperature. Furthermore, this limiting speed depends upon the pressure, it being higher for low pressures than for high. A worm having an angle which might be successful at low speed may fail at high speed; but it would seem that any worm which is successful at high speed should also be successful at low, which is in accordance with mechanical instinct.

(Concluded next week.)

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New Free List for Holland.

By a recent ministerial order the Government of the Netherlands has placed certain iron and steel articles and machinery on the free list, which will particularly interest certain American manufacturers and exporters. Included in the order are ventilators, exhausters and bellows which are worked by steam, gas, petroleum or electric motor only, and are used in factories, on ships, &c. Ventilators for ordinary ventilating purposes and not worked by the afore-mentioned motive power shall remain subject to the existing duty.

lathe and planer tools. This machine cost, probably, as much as a hundred of our ordinary grindstones cost, but I see that it automatically grinds all the tools for 300 high-priced mechanics, and it only works a few hours each day. The skilled mechanics in our country frequently stop their regular work to grind their own tools, and then they do it imperfectly. Your tools are all accurately ground to the best shape by the machine, so that they do more and better work on this account in a given time. I believe that that machine has brains—the brains of the inventor—and it has no doubt revolutionized work of this kind in American machine shops. This is but one case out of many that I have noted."

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The Fox Machine Company, of Grand Rapids, Mich., has applied a bicycle chain to the movement of the knife carriage of their universal trimmer. This chain takes the place of the rack and pinion and is applied at about the middle of the vertical hight of the carriage, thus doing away with practically all tendency to cramp the carriage within the sliding ways. The result is declared to be a very considerable improvement.

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Our British contemporary, "The Engineer," names among the important engineering achievements of the past year the great light it has thrown upon the matter of relative railroad speeds in America and England. Over here, however, it seems as though that light has flickered considerably.

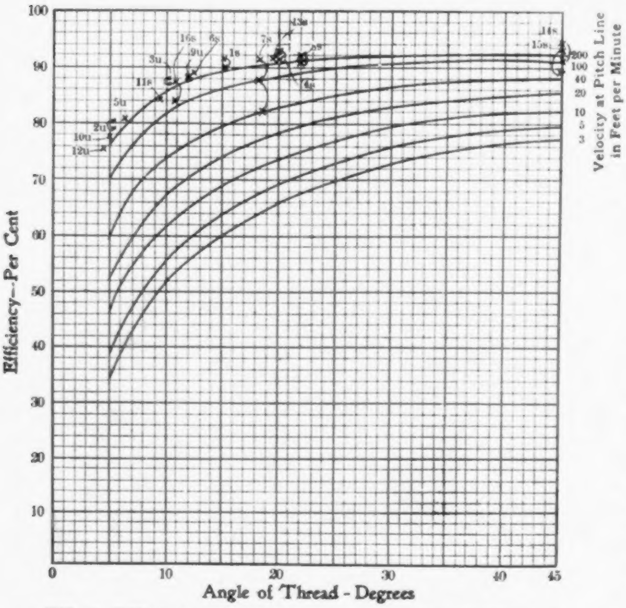


FIG. 3.—RELATION BETWEEN THREAD ANGLE, SPEED AND EFFICIENCY, WITH CASES FROM PRACTICE.

1. Hewes & Phillips, successful, velocity..........237 and 590 ft., steel worm and cast iron gear.
2. Hewes & Phillips, unsuccessful, velocity..........720 " 1,780 " " " " " " "
3. Hewes & Phillips, unsuccessful, velocity..........452 " 1,130 " " " " " " "
4. Hewes & Phillips, successful, velocity..........205 " 480 " " " " " " "
5. Newton Machine Tool Works, unsuccessful, velocity..........572 " " " " bronze "
6. Newton Machine Tool Works, successful, velocity..........375 " " " " " "
7. Newton Machine Tool Works, successful, velocity.......... 40 to 685 " " " " " "
8. Bertram & Sons, successful, velocity..........155 and 680 " cast iron " " cast iron "
9. Anonymous, unsuccessful, velocity..........250 " steel " " bronze "
10. Christie, unsuccessful, velocity.215 " " " " cast iron "
11. Christie successful, velocity.....190 " " " " " " "
12. Christie, unsuccessful, velocity.775 " " " " bronze "
13. Christie, successful, velocity.....328 " " " " " "
14. Anonymous, successful, velocity.116 to 555 " cast iron " " cast iron "
15. Anonymous, successful, velocity. 53 " 277 " " " " " " "
16. Anonymous, successful, velocity.118 " 860 " steel " " bronze "

Leaders connecting crosses indicate the same worm at different speeds; resistance of crosses above 200 foot line has no quantitative significance.

Modern Practice with Worm Gearing.—II.

BY F. A. HALSEY.

EXAMPLES FROM PRACTICE.

It is impossible to say who was the first to recognize the significance of the pitch angle as a factor in the satisfactory performance of worm gearing, but it may be mentioned as a matter of interest that the exhibit of the Hewes & Phillips Iron Works at the Newark Industral Exhibition of 1873 included several worm-driven planers, in which the worms were double threaded and had a pitch angle of 15° 15′, a pitch diameter of 3½ inches, a pitch of 3 inches, and a speed, cutting, of 256 and backing of 640 r. p. m., which give pitch line velocities of 237 and 590 feet. This worm was successful, and was many times repeated; but later on Hewes & Phillips were struck by the high belt speed idea, and in order to increase the belt speed they changed the worm to 6.16 p. d., 1¾ inches pitch, single thread; speed, cutting, 446, and backing 1,110 r. p. m., giving a pitch angle of 5° 15′ and pitch line velocities of 720 and 1780 feet. This worm was a failure, and was soon changed to 6.16 p. d., 3½ inches pitch, double thread; speed, cutting, 281, and backing 700 r. p. m., giving an angle of 10° 15′ and pitch line velocities of 452 and 1,130 feet. This worm did better than the last, but not so well as the first. By this time the lesson was learned, and Hewes & Phillips set out to use a worm of 30 degrees pitch angle. Structural considerations, however, prevented the use of so high an angle and they compromised on 20 degrees, the final worm resulting from this experience having a pitch diameter of 2.63 inches, with 3 inches pitch, quadruple thread, the speed cutting being 300 and backing 700 r. p. m., giving pitch line velocities of 205 and 480 feet, and this remained the standard angle as long as these planers were manufactured. The writer recently saw one of these 20 degree worm gears, which had been in use since 1885, opened up, and the wear disclosed was very slight—no shoulder being in existence after twelve years' use. As a result of the experience outlined above this house adopted the standard practice of making the worms as small as possible in diameter, and giving the threads in all cases a pitch angle of 20 degrees. The form of tooth used was the epicychloidal, while the materials used were hard cast iron for the gear and case-hardened open-hearth steel for the worms.

These Hewes & Phillips worms are plotted in Fig. 3 as crosses 1, 2, 3, 4, of which 1 is the 15° 15′, 2 the 5° 15′, 3 the 10° 15′ and 4 the 20°, the first and last being successes and the second and third failures.

In plotting these worms, and all others having pitch line velocities above 200 feet, the crosses are placed near and above the 200 feet curve. It is unfortunate that we have no curves for higher speeds, but Mr. Lewis recommends the use of the 200 feet line for all higher speeds. Leaders connecting different crosses indicate the same worm at different speeds in all cases. The letters *s* and *u* on the dia-

gram mean successful or unsuccessful in all cases.

Fig. 4 is a drawing of worm 3 (failure) and figure 5 shows worm 4 (success), and no more instructive pair of drawings could be imagined than these. The pitches are not far different, and what difference there is is in favor of the larger worm. The duty is the same, the gears are about the same diameter, and the revolutions per minute are nearly the same. The essential change is in the increase of the pitch angle by a reduction of the diameter, and this changed failure to success.

The Newton Machine Tool Works use worm gear in many of their machines, notably their cold saw cutting-off machines. In the earlier machines of this class the worm had a pitch diameter of 2⅞ inches, with a pitch of 1 inch, single thread, the revolutions per minute being 765. These figures give a pitch angle of 6° 20′, and a pitch line velocity of 572 feet. This machine could be operated, but not with satisfaction on account of the heating and short life of the worm. The worm was then increased in pitch by making it double threaded, giving a pitch angle of 12° 30′, the speed being reduced to 500 revolutions per minute, giving a pitch line velocity of 375 feet. The change proved to be a great improvement, heavier work than was before possible being done after the change without distress or difficulty, and this worm has since been applied to a large number of machines with entire success. A still later worm used on these machines has a pitch diameter of 3⅞ inches and a pitch of 4 inches, triple threads, giving a pitch angle of 18° 15′, and this is found to be a still further improvement. This last worm is used on a wide variety of machines and at a variety of speeds from 40 to 680 r. p. m., giving pitch line velocities of from 40 to 685 feet, and with uniformly good results. In many cases it is used without an oil cellar, though for comparatively light work. The form of thread used is the involute, and the material is hardened steel for the worm and bronze for the wheel. These Newton worms appear in Fig. 3 as 5, 6, 7, of which 5 is nearly a failure, while 6 and 7 are entirely successful. The second Newton worm—the one appearing in Fig. 3 as 6—is shown in Fig. 6.

Another habitual user of worms is John Bertram & Sons, of Dundas, Ontario, Canada, who employ them in all their planers, and use largely a worm of 3.18 inches pitch diameter, 4 inches pitch, quadruple threads, the speed, cutting, being 186 and reversing 744 r. p. m. These figures give a pitch angle of 22 degrees, and pitch line velocities of 155 and 620 feet. This worm appears in Fig. 3 as 8, the vertical position for the higher speed being again uncertain. These worms are highly successful, as the writer knows from repeated observation. Both worm and wheel are of cast iron, the thread being Brown & Sharpe standard. The Bertram worm is seen in Fig. 7. In reading this drawing it should be remembered that the conventional representation of a worm, with the threads shown by straight lines, shows a larger apparent pitch angle than the true one, as shown by a true projection.

Another case of failure was a worm drive applied to a large boring machine, the worm being 12 inches pitch diameter, 8 inches pitch, quadruple thread, speed 80 r. p. m. and above, worm of forged steel, wheel of bronze, oil cellar lubrication. These figures give a pitch angle of 12 degrees and a pitch line velocity of 250 feet. This worm is located on Fig. 3 as 9.

Still other cases of change from failure to success are supplied by Mr. Jas. Christie, of the Pencoyd Iron Works. The first of these relates to a boring machine, which was, by the makers, supplied with a worm drive having a worm 5½ inches pitch diameter, 1½ inch pitch, single thread, steel worm and cast-iron wheel, average speed 150 r. p. m. These figures give a pitch angle of 5 degrees and a pitch line velocity of 215 feet. This was a failure, but was successfully replaced by a worm of 4⅞ inches pitch diameter, 2½ inches pitch, at the same number of revolutions, which figures give a pitch angle of 9° 15′ and a pitch line speed of 190 feet. These two worms appear as 10 and 11. This successful worm lies in the region of unsuccessful ones, but the influence of the increased lead angle is unmistakable. The fact of its success is probably due to the pressure on the teeth being well below the working strength, or to the speed being moderate, or both.

The second case, of which the data were supplied by Mr. Christie, relates to two heavy milling machines, in which the cutter spindles were driven by worms 6 inches pitch diameter by 1½ inch pitch, single thread. It was found that the cutters could be run much faster than was originally contemplated, and the worms

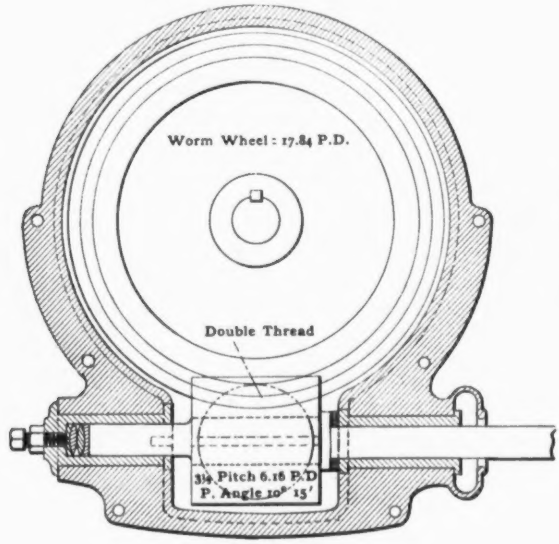


Fig. 4

HEWES & PHILLIPS' UNSUCCESSFUL WORM.

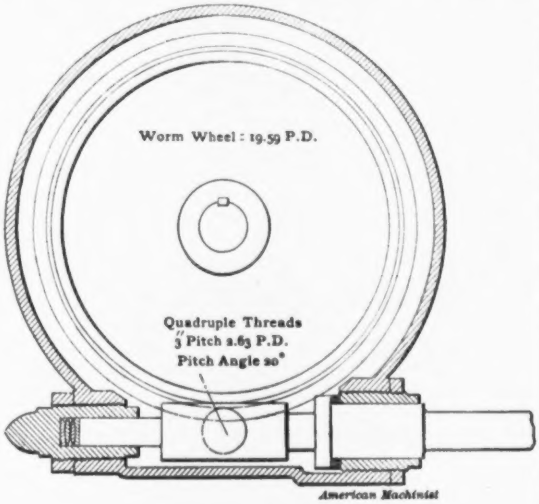


Fig. 5

HEWES & PHILLIPS' SUCCESSFUL WORM.

were consequently speeded up to about 500 r. p. m. In these machines cast-iron wheels were speedily destroyed, while hardened steel worms and bronze wheels would last about a year. Later two more machines were built having steel worms and bronze wheels, the worms being 4½ inches pitch diameter by 5 inches pitch, quadruple threads, speed 280 r. p. m. These worms have been in use six years, and are described as being "good as new." The data given for the first worm give a pitch angle of 4° 30′ and a pitch line velocity of 785 feet. It appears in Fig. 3 as 12. The pitch angle of the second worm is 19° 30′, and its pitch line velocity 328 feet. It appears in Fig. 3 as 13.

Mr. Christie has made many successful changes, of which these are typical, and he now uses worms with great freedom and success. His general conclusion is 45′, and a pitch line velocity of 118 to 845 feet per minute. While this worm is entirely successful, it was at first a failure, and was made successful only by careful attention to the materials used.

LIMITING SPEEDS AND PRESSURES.

A very important point connected with worm design, and one on which data are very scant, is the limiting pressures for various speeds at which cutting begins. The paper by Mr. Lewis contains some in- too high a pitch line velocity as well as because of too low a pitch angle.

The number of cases cited is too few for certainty in drawing general conclusions, but the testimony is unmistakable in its confirmation of the theory of the influence of the angle of the thread. It will be seen that every case having an angle above 12° 30′ was successful, and every case below 9° unsuccessful, the overlapping of the successful and unsuc-

	Single Thread Worm 1" Pitch 2⅜ Pitch Diam.				Double Thread Worm 2" Pitch 2⅜ Pitch Diam.			Double Thread Worm 2¼" Pitch 4¼ Pitch Diam.		
Revolutions per min ..	128	201	272	425	128	201	272	201	272	425
Velocity at pitch line in feet per min.......	96	150	205	320	96	150	205	235	319	498
Limiting pressure in pounds..............	1,700	1,300	1,100	700	1,100	1,100	1,100	1,100	700	400

LIMITING SPEEDS AND PRESSURES OF WORM GEARING.

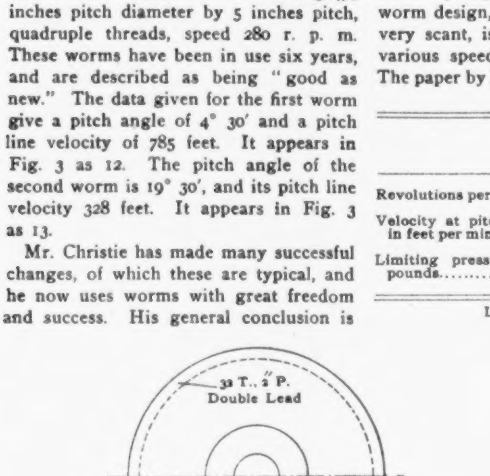


Fig. 6

THE NEWTON WORM AND STEP.

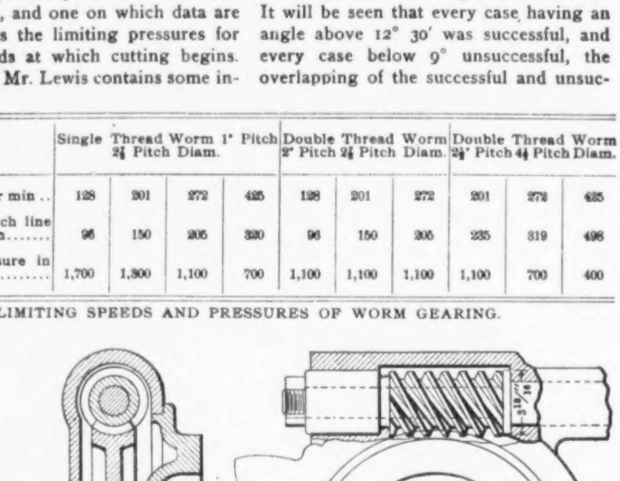


Fig. 7

THE BERTRAM WORM.

that good worms begin with those having the pitch about equal to the diameter, giving a pitch angle of 17° 15′.

Three other cases of successful worms under heavy duty are found in milling machines which have been repeated many times. The first two worms would be ordinarily described as spiral gears. The shafts are at right angles and the action is that of worms, and they are properly included here.

The first of these, which appears as 14 in the diagram, has a pitch diameter of 2¼ inches, a pitch angle of 45°, and a speed varying between 180 and 945 r. p. m., giving pitch line velocities of 106 to 555 feet per minute. Both gears are of cast iron. The second, 15 in the diagram, is of the same style, and has the same pitch diameter, with speeds varying between 90 and 472 r. p. m., giving pitch line velocities of 53 to 277 feet per minute. The third, 16 in the diagram, is a true worm, 2¼ inches pitch diameter, lead 1,333, triple thread, speed 200 to 1,442 r. p. m., bronze wheel and hardened steel worm. These figures give a pitch angle of 10° formation on this subject, and the accompanying table supplied by Mr. Christie, from experiments made by him, supplies the most definite additional data on the subject known to the writer. In all cases the worms were of hardened steel and the worm wheels of cast iron. Lubrication by an oil bath.

There is real need of a comprehensive series of experiments on this subject. It is obvious enough that a worm, otherwise well designed, might fail from having too high a speed for its load. Were such data at hand it would seem that with existing knowledge of effect of the speed and angle of the thread, worm design might be made a matter of comparative certainty. Especially should the behavior of worms at speeds above 200 feet per minute be subjected to further experiment, as it is frequently necessary to use speeds above that figure, and there can be no doubt that higher speeds are entirely feasible if suitable pressures accompany them. The speed as a factor should be kept in mind equally with the pitch angle. A worm may fail because of cessful worms in the intervening region being what is to be expected in the border region between good and bad practice. This band of uncertain results is in fact narrower than we would have any right to expect from a collection of data from miscellaneous sources, and could the inquiry be widened in scope the width of this band would doubtless be increased. As throwing light on these cases it should be remembered that case 16 is known to have been made successful only by careful attention to the material used, the first worms made having been failures, and that 3, which is near 16, and was a failure, had an excessive speed, while 11 at a lower angle, and a success, had a very moderate speed. At a higher speed 11 would probably have failed, and at a lower speed 3 would probably have been a success. It is believed that Fig. 3 points out clearly the nature of the worm problem and the conditions of success in its solution.

STEP BEARINGS.

The step bearings of worms have been a source of trouble alongside of the worm

. It is obvious enough that the in-
e of the thread angle will relieve
step of wear as well as the worm
ds. Expedients are possible with
step, however, which are not avail-
with the worm. Ball and roller step
ngs have been extensively used, and
e some have been successful with
, the general results are believed to
been unsatisfactory. The troubles
ball bearings arise from the ten-
of the balls to break up under heavy
and to score the pressure plates,
conical rollers, which geometrical
derations call for, have in some in-
es made trouble from their outward
l pressure cutting out the confining
The multiple washer thrust bear-
s used by many, and is undoubtedly
ely successful. Many of the readers
is article have no doubt seen this
rn of bearing without reflecting
the principle which lies at the bot-
of it. When several loose washers
nterposed between the shaft collar
he face of the shaft bearing, it is ob-
that slipping may occur between
pair of faces, and that this slipping
take place between those surfaces
at the moment offer the least fric-
Should these surfaces from any
increase their resistance the slip-
will be at once transferred to an-
point, the various surfaces acting as
al safety valves to one another, any
ce which gets into the condition of
ent heating or cutting being at
relieved by another taking up the
Fig. 6 shows one of these bear-
as made by the Newton Machine
Works. The Newton Works former-
lowed the usual practice and made
washers a alternately of hardened
and bronze, but consider that they
improved on this by substituting
cast iron for the steel. These cast-
re obtained from the malleable iron
ries, and are in fact unannealed
able castings. Of course these cast-
cannot be machined, and they are
ore prepared for use by grinding
cup-shaped emery wheel. They are
ed into a socket on the end of a
which is revolved by hand, and are
presented to the face of the cup-
l wheel. This plan results in the
ng marks crossing the faces in all
ons, instead of being in circles as
he-finished pieces. All mechanics
stand the advantage of having the
marks in a direction different from
f the motion of the parts, which ad-
ge this method of construction se-
Another feature of the Newton
gs consists in making the holes in
washers larger than the shaft on
they are placed. This construction
uces an irregular compound mo-
of the surfaces upon one another,
lvantages of which are well under-
In the Newton washers the holes
32 inch larger than the shaft, though
Mr. Newton considers that this might be increased with probably good results.

Three radial oil grooves are cast in each face of these disks, the use of which is obvious. The Hewes & Phillips step, at the right-hand bearing, will be seen to include three washers, while the left-hand step has lenticular-shaped disks—a pattern which has also found favor elsewhere.

▲ ▲ ▲

Errata.

In spite of careful corrections of proof, our printer made a general mess of the formulas which appeared in last week's installment of the article on "Modern Practice with Worm Gearing." The first equation for the efficiency of worms without steps should have read

$$e = \frac{\tan \alpha \, (1 - f \tan \alpha)}{\tan \alpha + f}$$

in which

e = efficiency.

α = angle of thread, being the angle $d\,f\,i$ of Fig. 1.

f = coefficient of friction.

The equation for the efficiency of worms with steps should have read:

$$e = \frac{\tan \alpha \, (1 - f \tan \alpha)}{\tan \alpha + 2f} \quad \text{(approximately).}$$

The equation for tan α at maximum efficiency of worm thread alone should have read:

$$\tan \alpha = \sqrt{1 + f^2} - f$$

Substituting the value of f (.05) this becomes

tan α for maximum efficiency = .9512.

▲ ▲ ▲

Electrical Distribution of Power.

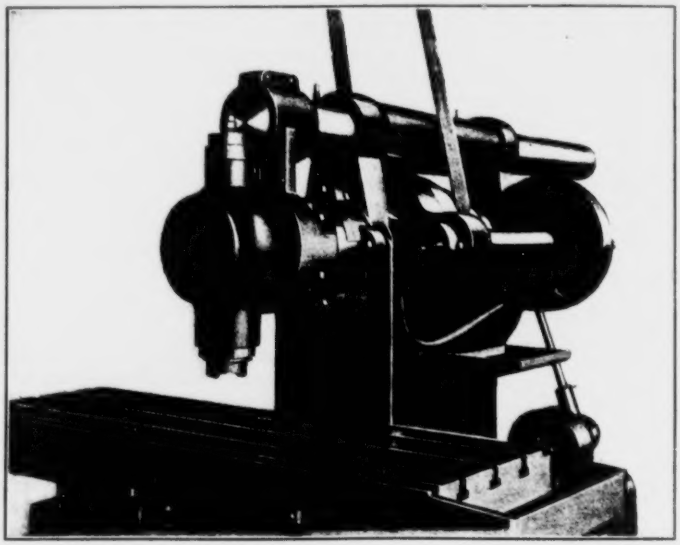
BY WILLIAM O. WEBBER.

I was recently somewhat surprised to read that the driving of factories by electric motors in Europe and on the continent is still regarded as an experimental or problematical thing to do. And yet I do not think that the advantages to be derived from this method of driving are as yet fully appreciated in this country. In recent years it has been my privilege to plan out the electrical driving for a number of factories of different kinds, and I have always, in the first place, ascertained just what saving could be made by driving factories electrically, both from steam and water power as a source, as against driving them directly by shafting and belting. I think, in the first place, that very few people realize the large per cent. of loss in factories of all kinds due to shafting and belting. The per cent. of loss in this way is not only very great, but very variable, and it not only varies very largely from one type of factory to another, but there is also a large variation in different factories of the same type and doing the same class of work. Probably one of the best examples of a small loss of power from these causes is a modern high speed cotton mill, where the total loss does not exceed 18 per cent., whereas some of the older cotton factories lose as much as 25 per cent. To go to the other extreme, the largest loss is in such plants as large locomotive works, boiler shops, bridge works and other plants, where the machine tools are large and are distributed at intervals over a large floor area. In this type of factory the loss, determined by actual tests, runs as high as 80 per cent. Machine shops and wood-working establishments probably come next, the loss being from 50 to 60 per cent., and I have recently tested some woollen and felting mills where the per cent. of loss was from 35 to 40 per cent. I have also made a number of tests recently in warehouse buildings, in large cities where power is furnished to a number of small industries on each floor, and in these cases the loss of power in shafting and belting is a very large per cent. of the total power developed by the engines.

Another very much misunderstood question is that of the relative cost of steam and water power. Of late years there has been a very strong prejudice in favor of steam power, it being generally believed that, by reason of improved boilers and engines, almost all steam power could be produced for $25 per horse-power per year; whereas, as a matter of fact, it is only in large factories, using large compound condensing engines, that this figure can be attained. The ordinary small factory, with an engine of, say, from 100 to 125 horse-power, running 10 hours per day for 308 days in the year, with coal at $3 per ton, will find it impossible to produce a horse-power for less than $53 per annum; and if the same factory is run 365 days in the year, 24 hours per day, the cost on the same basis would be $76, or, if run 24 hours per day for 308 days in the year on the same basis, the cost per annum would be $69. On smaller engines than these just cited the costs would be increased; so that for 308 days of 10 hours the power for a 50 horse-power engine would be nearly $100 per annum.

On the other hand, as we go toward larger plants, these costs decrease, so that 200 horse-power should be obtained for $45; 300 horse-power, for $37.50; 400 horse-power, for $33; 500 horse-power, for $30 per horse-power; and I find that we do not reach the figure of $25 per horse-power until we get as high as 850 horse-power. As the extreme low limit, I believe recent figures of a large thread mill making 2,000 horse-power under extremely favorable conditions, have brought the cost slightly under $12 per horse-power; but this is exceptional.

On the other hand, the horse-power from falling water is relatively much cheaper for small plants. I believe that a small 100 horse-power water plant would produce a horse-power for $33 per annum, and 200 horse-power from water has been produced for $13 per annum,



VERTICAL SPINDLE MILLING HEAD FOR CINCINNATI MILLER.

New Vertical Spindle Milling Head.

We show herewith a photograph and detail section drawing of a new vertical spindle milling head for use on heavy knee-type milling machines. The photograph shows the head attached to a machine. The drawing, which is a section on a vertical plane through the horizontal and vertical spindles, shows the construction and size, and is self-explanatory. The head can be swiveled in a vertical plane through 360 degrees. The circle bearing the graduations is divided into degrees and is $8\frac{5}{8}$ inches in diameter, so that graduations are readily seen and accurately set. The cutter shanks are clutched to the spindle, as shown, so that this takes the place of the usual tang on the end of shanks. In this case the ends of the shanks are tapped $\frac{5}{8}$"-11, to fit the bolt shown and by which they are firmly secured. The bolt is provided with a shoulder near its head, so it can be used for backing a shank out as well as for drawing it in.

The attachment is made by the Cincinnati Milling Machine Company, and is especially designed for use on their No. 3 and No. 4 machines.

Spiral Gears—I.

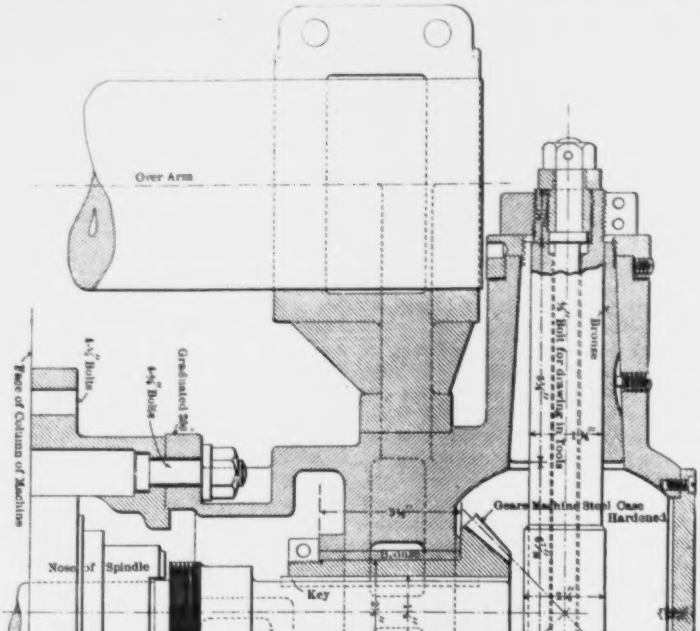
BY F. A. HALSEY.

SPIRAL GEARS COMPARED WITH SPUR GEARS—THE DIFFERENT PITCHES.

The following article may not be essentially any clearer than those which have already been published in these columns, but it presents the subject from a somewhat different standpoint and with greater fullness of illustration, and it may thus assist some in obtaining a comprehensive idea of just what the spiral-gearing problem is.

Spiral gears are not to blame for the undoubted fact that they are somewhat troublesome to lay out, the difficulties of the problem being due to the limitations of workshop facilities and not to the geometrical nature of the gears themselves. It is easy to understand and explain the action of an existing pair of spiral gears. More than this it is easy to lay out a pair of such gears which shall exactly meet all the conditions of the case except one—they cannot, except through rare good luck, be made with the appliances at hand. To be more specific, the circumference cannot usually be divided into an exact whole number of teeth by any stock cutter, and the real problem becomes the readjusting of the diameters of the gears and the angle of the teeth, so that stock cutters shall make an exact whole number of teeth.

With spur gears it is only necessary to multiply the (circumferential) pitch of the cutter by the number of teeth to be cut to obtain the circumference of the gears. With spiral gears this operation gives the length of a portion of a spiral, or, more properly, helix, wound upon the pitch surface. We do not know the angle of this



VERTICAL MILLING HEAD, VERTICAL SECTION.

helix, the diameter of the pitch cylinder upon which it is wrapped or even what part of a complete turn the known portion comprises. The length is known for each gear and nothing more, and it becomes a matter of trial to find the diameters of the gears and the helix angle to suit this portion of the helix and at the same time fill the required center distance.

Fig. 1 is a conventional representation of the pitch surface of a spiral gear, the surface being extended beyond the limits of the gear in order that the two helixes with which we are concerned may be shown. The first of these, *a b c d e f*, is the tooth helix and the second, *a g h d i p*, is the normal helix. The tooth helix is of importance because it defines the angle of the teeth. Given the diameter of the pitch surface, the helix may be defined by the angle *k a l* or by the length *a f*, in which it makes a complete turn—that is, by its pitch. For the determination of the speed ratio of a pair of gears the former method is the more convenient, but the tables supplied with universal milling machines which are used in setting up the machine employ the latter method.

In all spiral gear problems we have too pitches to deal with—the pitch of the tooth helix and the pitch of the teeth. The latter may be measured in several ways. First is the value *a n*, measured on the circumference or the *circumferential pitch*, which is analogous to the pitch of spur gears; second is the value *a o* measured on the normal helix or the *normal pitch*, for which the cutters must be selected; third is the value *a r* measured parallel with the axis or *axial pitch*.* Since the cutters must be selected with reference to the normal pitch the length of the normal helix is naturally of importance in connection with the number of teeth in the gear. The normal pitch multiplied by the number of teeth must naturally equal the length *a g h d* of this helix measured between its intersections *a* and *d* with the helix of a single tooth. Note that the length of the normal helix to be considered is the length *a g h d* between its intersections with the tooth helix and not the length *a g h i p q* of a complete turn around the cylinder. That this is true may be seen by reference to Fig. 2, in which the angle *k a l* is nearly a right angle. It is apparent from this illustration that the length of the normal helix from *a* to *d* takes in all the teeth and that *a o*, multiplied by the number of teeth, must equal *a h p d* and not *a h p q*. This length *a h p d* is always less than *a h p q*, and usually much less. Fig. 3 *A* is a development of Fig. 2 on a reduced scale, *a d* being the developed length of the normal helix. Fig. 3 *B* and Fig. 3 *C* show how with the same circumferential pitch and the same number of teeth but a reduced value of the angle *k a l*, the length of the normal helix which cuts all the teeth grows shorter until it may make but a small part of a complete turn around the cylinder. It is clear that in all cases the line *a d* cuts all the teeth precisely as does the circumference *a a*, which goes completely around the cylinder. It is also clear that if the normal pitch is decided upon at the start, a diameter of cylinder and a helix angle must be found such that the normal pitch, multiplied by the number of teeth, shall equal the length of the normal helix between two intersections with the tooth helix.

It is natural to ask: Why not employ the circumferential pitch and so deal directly with the circumference instead of the normal helix? Because we do not know what it is. The normal pitch is determined by the cutter used, while the circumferential pitch depends also upon the helix angle, and until this angle is known the circumferential pitch is not known.

In the extreme case of a spiral gear in which the helix angle is so small that the gear becomes a single thread worm, as in Fig. 4, points *o* and *d* coincide and the length of the helix between *a* and *d* becomes the normal pitch. It is, however, true as before that the normal pitch, multiplied by the number of teeth, which is now one, is still equal to the length of the normal helix between two intersections with the tooth helix.

A glance at Fig. 3 will show that in gears of the same diameter the length of the normal helix* grows shorter as the angle *k a l* grows less, and hence that it and its gear will contain successively fewer and fewer teeth of the same normal pitch. That is to say, the number of teeth in a gear varies with the helix angle as well as with the diameter and *the number of teeth in two gears of the same normal pitch is not necessarily proportional to the diameters.* In fact, it is never so proportional, except when the angle *k a l* is equal to 45 degrees. *The diametral pitch of the cutters and the diameter of the gear thus do not determine the number of teeth.*

The two facts thus developed are fundamental and will bear re-stating:

First, *the number of teeth is equal to the length of the normal helix divided by the normal pitch.*

Second, *the numbers of teeth in a pair of gears are not proportional to the diameters, except when the angle of the tooth helix is 45 degrees.*

THE SPEED RATIO.

Fig. 5 illustrates the simplest possible case of a pair of spiral gears. The gears are of equal size and the tooth helix has an angle of 45 degrees. Such a pair of gears will obviously run at the same speed—that is, have a speed ratio of 1—and as obviously both will have the same number of teeth. Now, unlike spur gears, there are two ways in which the speed ratio of such a pair of spiral-gears may be varied. First, the diameters of the gears may be changed, as with spur gears, the angle of the tooth helix remaining unchanged, as in Fig. 6; and second, the angle of the helix may be changed, the diameters of the gears remaining unchanged, as in Fig. 7. These methods act in very different ways. The first method is analogous to the procedure with spur gears. As with spur gears, the circumferential or pitch line speed of the two gears remains, as before the change, equal, but the length of the circumference of the two gears is unequal and the larger one thus has a less number of revolutions than the smaller one. The second method is entirely unlike anything seen in connection with spur gears. By it the pitch line speeds of the two gears are made unequal, and hence, while their diameters are equal, the lower one revolves the more slowly. This points out another fundamental difference between spiral and spur gears: With spiral gears, unless the helix angle is 45 degrees, *the pitch line speeds of two mating gears are not the same.*

The two methods of changing the speed ratio shown in Figs. 6 and 7 may be combined. That is, part of the desired change in speed may be obtained by changing the diameters of the gears and the remainder by changing the angle of the helix. Given the speed ratio and the diameter of one of the gears, we may assume a helix angle and find a diameter for the second gear to go with it which shall give the desired speed ratio and, having done this, a second angle may be assumed and a second diameter be found. There are thus an indefinite number of combinations of angles and diameters which will give the required speed ratio. Note, however, that with the diameter of one gear fixed, every change in the diameter of the other changes the distance between centers, that not every angle of helix can be obtained by the gears which are furnished with universal milling machines, and that if ready-made cutters are to be used, the lengths of both normal helixes must be exact multiples of the normal pitch of the teeth. The problem of designing spiral gears thus consists of finding a pair which shall have a given center distance, helix angles which can be cut with the means at hand, and such a normal pitch that stock cutters can be used. Remove these restrictions and laying out a pair of spiral gears becomes simple. It is, in fact, frequently necessary to remove one of them, namely, the helix angle limitation, by making new gears for the spiral head which shall cut the angle desired.

Geometrically speaking, there is a wide range of choice in the helix angle. As regards the desirability of different angles

*Of two mating gears the circumferential pitch of one is equal to the axial pitch of the other, and vice versa. The axial and circumferential pitches are of small importance, except in the case of worm gearing. In making a worm we deal with axial pitch, and in making a worm wheel, with circumferential pitch. In such spiral gears as are made with a formed milling cutter (not a hob) we are concerned chiefly with normal pitch.

*"Length of normal helix" is to be understood as meaning the length of that helix between two intersections with the same tooth helix.

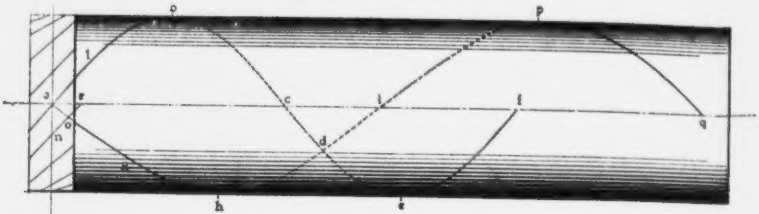


Fig. 1

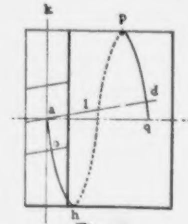


Fig. 2

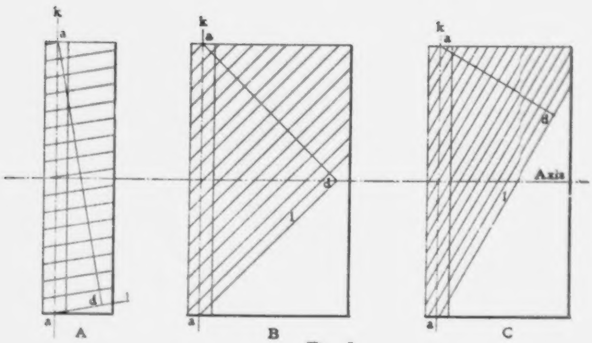


Fig. 3

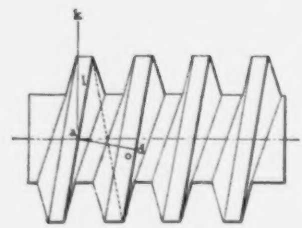


Fig. 4

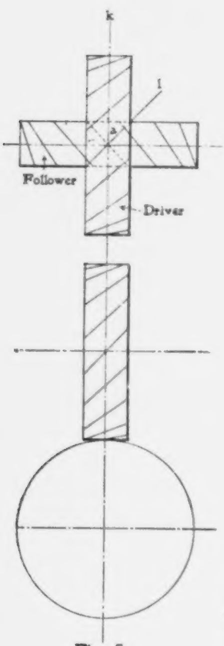


Fig. 5

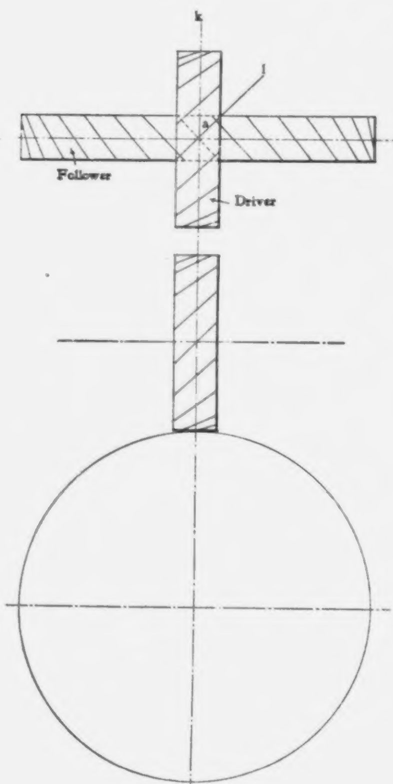


Fig. 6

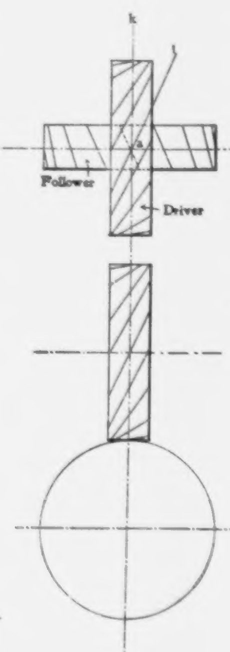


Fig. 7

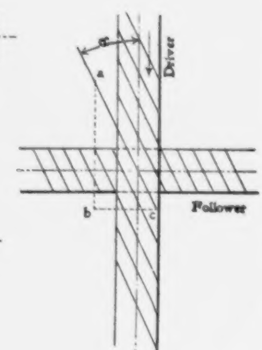


Fig. 8

American Machinist

THE ACTION OF SPIRAL GEARING.

from the standpoint of durability, the conditions are essentially the same as in worm gearing. Reference to the article, "Modern Practice with Worm Gearing," published in the issues of January 13 and 20, 1898, will show that the most favorable angle for durability is 45 degrees. There is, however, but a trifling increase in wear down to 30 degrees, no serious increase down to 20 degrees, and no destructive increase down to about 12 degrees. Where gears are to transmit considerable power the best results should attend the use of angles between 30 and 45 degrees, while angles as low as 20 degrees may be used without hesitation, and as low as 12 de-

grees if the gears are to run in an oil bath or do light work only. The angle may also be increased above 45 degrees by similar amounts and with similar results.

Fig. 8 is a development of the gears of Fig. 7, the angle α of Fig. 8 being equal to $k\,a\,l$ of Fig. 7, but in reversed position, because in Fig. 7 the upper side of the driver is seen, while in Fig. 8 the direction of the teeth is that of the lower side of the driver.

It is clear that if the driver move in the direction of the arrow it will, while moving the distance $a\,b$, push the driven gear the distance $b\,c$, and the pitch line speeds will have the relation:

$$\frac{\text{p.l. speed follower}}{\text{p.l. speed driver}} = \frac{b\,c}{b\,a} = \tan.\ \alpha.$$

If the gears have the same diameters, their number of revolutions will be in the same ratio as their pitch line speeds—that is:

$$\frac{\text{rev. follower}}{\text{rev. driver}} = \tan.\ \alpha$$

or

$$\text{rev. follower} = \text{rev. driver} \times \tan.\ \alpha.$$

If the diameter of the follower be increased, its number of revolutions will be reduced in the same ratio—that is:

$$\text{rev. follower} = \frac{\text{diam. driver}}{\text{diam. follower}} \times \text{rev. driver} \times \tan.\ \alpha,$$

or

$$\frac{\text{rev. follower}}{\text{rev. driver}} = \frac{\text{diam. driver}}{\text{diam. follower}} \times \tan.\ \alpha,$$

the angle α being taken from the driver.

This is a complete formula for the speed ratio of spiral gears having shafts at right angles. But for the limitations imposed by the use of stock cutters it, together with the fact that the sum of the diameters of the gears must equal twice the center distance, would be all that is required for designing such gears. Note that it differs from the corresponding formula for spur gears only by the introduction of the factor tan. α.

(Continued next week.)

A Graphical Method of Laying Out the Corner of an Elevator Car.

BY F. B. KLEINHAUS.

The corner of an elevator hatch has been found a convenient place for the guide, which, as a usual thing, is laid out by a trial method. Twelve inches across the corner is a common requirement for the safety device (see Fig. 1). When the car is square it is easy to lay off a line 12 inches long across the corner at an angle of 45 degrees to the center line, but ninety-nine times out of a hundred the car isn't square, and then the problem is not so easy.

The usual method is to take two triangles, placing the right angle of one against the side of the other, and, having found the center of the car, the triangles are slid around until a position is found where the center line is 6 inches from the line of the hatchway on either side. Anyone who has had to lay off the corners in this way will appreciate the graphical method shown in Fig. 2. The center of the car is shown at C, and $A\,O\,B$ is the line of the hatchway. It is required to find a line $D\,G$ in such a position that a normal to its center F will pass through the center C.

From O, as a center, with a radius r equal to 6 inches, describe the arc shown. Select two points D_1 and D_2, one above, and the other below the point where you think D would come; connect them to the center C, and describe the semicircles E^1 and E_2 on them. With a radius of 6 inches and D_1 and D_2 as centers, describe arcs as shown, cutting E_1 and E_2 at the points S and R respectively. Through S and R draw a straight line which will cut the original arc, struck from O, at some point F. Join F and C, and through F draw a line $D\,G$ at right angles to $F\,C$. This line will be 12 inches long, and will have $F\,C$ normal at its center, which is the required condition.

As a proof, we know that the center F of the line $D\,G$ describes a quadrant of a circle when it is made to slide on the right angle $A\,O\,B$, the radius of this circle being r. F is therefore in the arc struck from the point O, with a radius r. If another curve can be found which contains F, their intersection will determine the point.

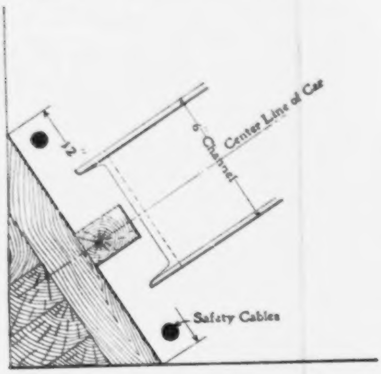


Fig. 1

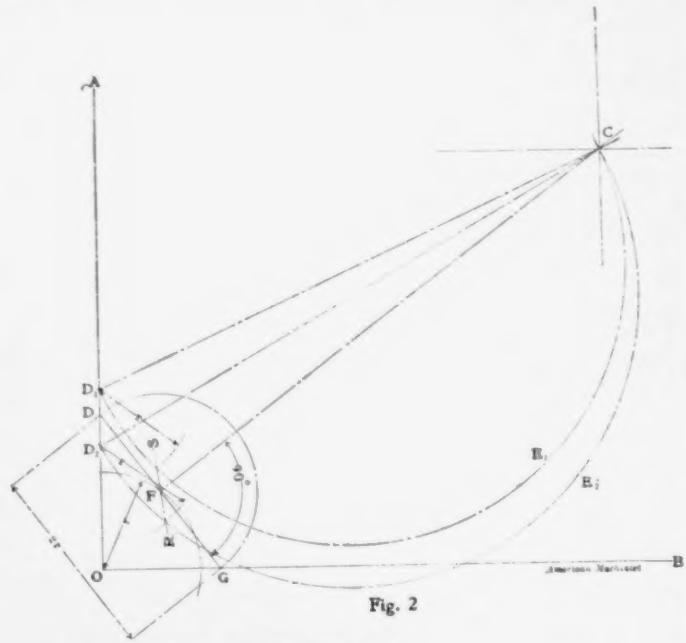


Fig. 2

LAYING OFF THE CORNERS OF AN ELEVATOR HATCH.

Referring to Fig. 3, the line $D\,G$ is shown with $F\,C$ normal at its center. From D as a center, and r as a radius, strike an arc as shown. This arc will pass through F, $D\,G$ being equal to $2r$. $D\,F\,C$ is a right angle, and therefore if we strike a semicircle on $D\,C$ it will pass through F. By taking a series of points D_1, D_2, D_3, etc., along $A\,O$, connecting them to the center, describing semicircles on them, and then from each point striking an arc, with the radius r as shown, a series of points K_1, K_2, K_3, etc., will be determined. Connecting them by a line $K_1\,K_3$, this line is seen to be straight for a considerable distance on each side of F. It is therefore only necessary to make the construction for two points, in order to determine the line.

One other thing will be noticed, namely, that the centers of the semicircles struck

the corners, and consequently it was necessary to accomplish the act of making these changes as nearly instantaneously as possible. This explanation is deemed necessary because the experiment was as much a test on the machine as it was a trial of the method. The two are inseparable so far as the data given in this article are concerned. The cutter used was made by the Cincinnati Milling Machine Company.
CHAS. S. GINGRICH.
Cincinnati, Ohio.

Spiral Gears—II.

BY F. A. HALSEY.

THE PRELIMINARY SOLUTION.

The simple formula for the speed given at the conclusion of the last article will be needed repeatedly, and had best be put in algebraic form.

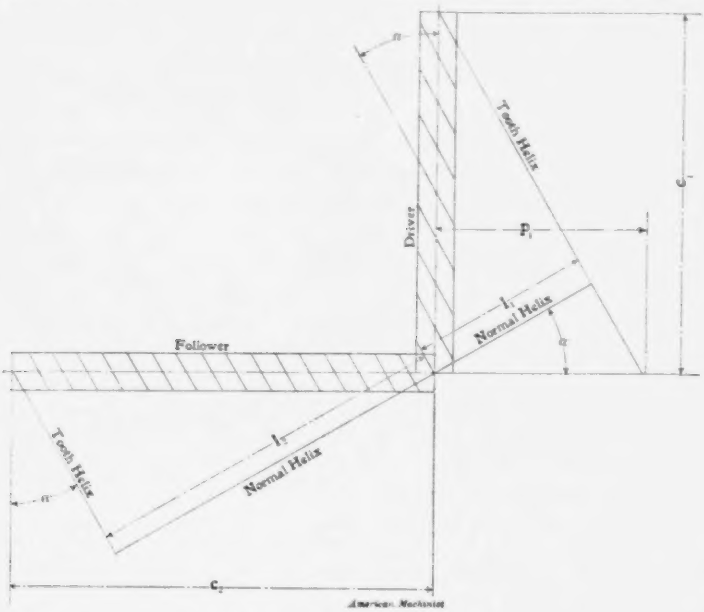


FIG. 9. A PAIR OF GEARS DEVELOPED.

Let r_1 = revolutions of driver,
r_2 = revolutions of follower,
d_1 = diameter of driver,
d_2 = diameter of follower,
α = helix angle of driver.

Then this formula becomes:

$$\frac{r_2}{r_1} = \frac{d_1}{d_2} \tan. \alpha \qquad (1)$$

In any actual case the speeds are given and the diameters and helix angle must be found. We may assume a ratio for the diameters and find the angle, or we may assume an angle and find the ratio of diameters. It is desirable to assume the angle first, as on it depends, largely, the durability of the gears. To do this the above formula may be more conveniently written:

$$\frac{d_2}{d_1} = \frac{r_1}{r_2} \tan. \alpha \qquad (2)$$

The sum of the diameters must equal twice the center distance, which we may call C. That is:

$$d_1 + d_2 = 2\,C,$$

or

$$d_2 = 2\,C - d_1.$$

Substituting this value for d_2 in (2) we obtain:

$$\frac{2\,C - d_1}{d_1} = \frac{r_1}{r_2} \tan. \alpha$$

which, solved for d_1, becomes:

$$d_1 = \frac{2\,C}{\frac{r_1}{r_2} \tan. \alpha + 1} \qquad (3)$$

Having assumed a value for α and substituted its tangent and the ratio of the desired speeds in (3), we find a value for d_1, and, having found d_1, d_2 may obviously be found by subtracting d_1 from $2\,C$.

Such a solution is complete in a geometrical sense, and if it were feasible to make a cutter to suit each case, it would be complete in a practical sense also. When, however, we go a step further and find the length of the normal helixes, the probabilities are all against their being exact multiples of the pitch of any stock cutter. The solution so obtained must therefore be considered as provisional and be modified to suit the cutters to be used. When the adjustment to suit the cutters has been made, it is still a matter of chance if the resulting angle can be cut with the gears supplied with the spiral head of a universal milling machine, and again the probabilities are against it. Eventually one of these conditions can always be met exactly, but both of them rarely. If both are to be met exactly or with close accuracy, it is frequently necessary to make new gears for the spiral head.

THE LENGTHS OF THE NORMAL HELIXES.

Fig. 9 is the development of a pair of gears placed in the most convenient position for showing the lengths of the normal helixes. The tooth and normal helixes are extended beyond the face of the gears. Let

c_1 = circumference of driver,
c_2 = circumference of follower,
d_1 = diameter of driver,
d_2 = diameter of follower,
l_1 = length of normal helix of driver between intersections with tooth helix,
l_2 = length of normal helix of follower between intersections with tooth helix,
α = tooth helix angle of driver.

Obviously

$$l_1 = c_1 \sin. \alpha,$$
$$= \pi\, d_1 \sin. \alpha,$$

or

$$\frac{l_1}{\pi} = d_1 \sin. \alpha \qquad (4)$$

$$l_2 = c_2 \cos. \alpha,$$
$$= \pi\, d_2 \cos. \alpha,$$

or

$$\frac{l_2}{\pi} = d_2 \cos. \alpha \qquad (5)$$

Note that (4) and (5) give the lengths of the normal helixes divided by π and not their actual lengths. This is done because, in dealing with diametral pitch cutters the calculations are made less laborious. Dividing (4) by (5) gives:

$$\frac{l_1}{l_2} = \frac{d_1 \sin. \alpha}{d_2 \cos. \alpha}$$
$$= \frac{d_1}{d_2} \tan. \alpha \qquad (6)$$

Comparing (1) with (6) proves what is almost self-evident, that the lengths of the normal helixes are to each other inversely as the number of revolutions, and hence that *a pitch which will exactly divide the short helix will also divide the long one* and that *the numbers of teeth in the gears are inversely as the speeds.*

A PRACTICAL EXAMPLE.

An example will best illustrate the actual procedure and for this the one given by Mr. De Leeuw in issue No. 2 of last year will answer as well as any. In that example:

$$\frac{\text{revolutions of follower}}{\text{revolutions of driver}} = \frac{r_2}{r_1} = \tfrac{1}{4}$$

and

$$\text{center distance} = C = 4\tfrac{15}{32}$$
$$= 4.468 \text{ inches.}$$

Mr. De Leeuw could not use a helix angle of 45 degrees because it led to a diameter for the driver which was too small for its shaft. We are, at the start, entirely at sea regarding the whole matter; but as an angle of 30 degrees is favorable to durability we may use it as a trial angle and see what it will lead to. Finding the tangent of 30 degrees in a table and substituting it and the value of $\frac{r_1}{r_2}$ in (3) we obtain:

$$d_1 = \frac{2 \times 4.468}{4 \times .57735 + 1}$$
$$= 2.7$$

and

$$d_2 = 2 \times 4.468 - 2.7$$
$$= 6.236.$$

From (4) we find

$$\frac{l_1}{\pi} = 2.7 \times .5$$
$$= 1.35$$

and from (5)

$$\frac{l_2}{\pi} = 6.236 \times .866$$
$$= 5.4.$$

These values of d_1, d_2, $\frac{l_1}{\pi}$, and $\frac{l_2}{\pi}$ are the provisional values belonging with 30 degrees for α.

Mr. De Leeuw desired to use 6 pitch cutters, the circumferential pitch of which is $\frac{\pi}{6} = .5236$. We may find the number of teeth which the normal helixes will contain by dividing their lengths by this circumferential pitch, but

$$l \div \frac{\pi}{6} = \frac{l}{\pi} \times 6.$$

That is, the number of teeth of 6 diametral pitch which the provisional normal helixes will contain may be found by multiplying $\frac{l_1}{\pi}$ and $\frac{l_2}{\pi}$ respectively by 6. Performing this operation we obtain:

$$\frac{l_1}{\pi} \times 6 = 1.35 \times 6$$
$$= 8.1$$

and

$$\frac{l_2}{\pi} \times 6 = 5.4 \times 6$$
$$= 32.4.$$

The provisional normal helixes thus contain 8.1 and 32.4 teeth of the desired pitch, and as these numbers are impossible, we take the nearest whole numbers having the desired ratio of 1 to 4, namely, 8 and 32. That is, we decide to shorten the normal helixes until they contain exactly 8 and 32 teeth.

The meaning of this is shown graphically in Fig. 10. Laying down $a\,b$ and $a\,c$ to represent the circumferences as found above and drawing the normal helixes at an angle of 30 degrees, we have found that the normal helix $a\,d$ of the driver will contain 8 teeth and a little more, and the normal helix $a\,e$ of the follower 32 teeth and a little more. As we cannot have a fraction of a tooth, we decide to cut off the ends of the helixes, making their lengths $a\,d'$ and $a\,e'$.*

FINAL SOLUTION BY CHANGING THE CENTER DISTANCE.

The most obvious way of carrying this out is to simply reduce the diameters of both gears, so as to make their circumferences $a\,b'$ and $a\,c'$ instead of $a\,b$ and $a\,c$. This change obviously reduces the center distance, but at this drawing-board stage of affairs this can often be done, and when it can be done it is the readiest way out of the difficulty. To determine how much to reduce the diameters we must first find the reduced lengths of the normal helixes, which must be such that:

$$\frac{l_1}{\pi} \times 6 = 8$$

or

$$\frac{l_1}{\pi} = \frac{8}{6}$$
$$= 1.333$$

and

$$\frac{l_2}{\pi} \times 6 = 32$$

or

$$\frac{l_2}{\pi} = 5.333.$$

Knowing these corrected values of $\frac{l_1}{\pi}$ and $\frac{l_2}{\pi}$, it is easy to find the new diameters. It is apparent from Fig. 10 that the ratio between the provisional and final diameters is the same as that between the lengths of the provisional and final helixes, which latter is 8.1 to 8, or its equal 32.4 to 32. That is:

$$\frac{\text{final diameter}}{\text{provisional diameter}} = \frac{8}{8.1}$$

or

$$\text{final diameter} = \text{provisional diameter} \times \frac{8}{8.1}$$

That is:

$$\text{final } d_1 = 2.7 \times \frac{8}{8.1}$$
$$= 2.667$$

and

$$\text{final } d_2 = 6.236 \times \frac{8}{8.1}$$
$$= 6.159$$

and $d_1 + d_2 = 2.667 + 6.159 = 8.825 =$ twice the new center distance.

GRAPHICAL SOLUTION WITH CHANGED CENTER DISTANCE.

All these determinations may be made graphically as in Fig 11. Lay off $a\,b = 2\,C = 8\frac{13}{16}$ inches. At any convenient distance lay off the indefinite line $c\,d$ parallel to $a\,b$. At c lay off the provisional angle $\alpha = 30$ degrees. Draw $e\,f$ at any convenient point perpendicular to $c\,d$. Take $e\,f$ in the dividers and step it off from e toward d as many times as will represent the ratio of the desired speed of the driver divided by that of the follower. That is, in the present case, lay off $e\,f$ 4 times above e and thus obtain d. Draw $c\,a$ and $d\,b$ and extend them till they meet at g.* Draw $g\,e$, giving $a\,h$ and $b\,h$, which are provisional diameters of driver and follower respectively. Draw $h\,p$ perpendicular to $a\,b$, at h lay down $h\,k$ and $h\,l$ to repeat α, and from h strike arcs $a\,k$ and $b\,l$. Draw $k\,o$ and $n\,l$ perpendicular to $a\,b$, and we have the provisional values:

$$a\,h = d_1$$
$$b\,h = d_2$$
$$h\,o = \frac{l_1}{\pi}$$
$$h\,n = \frac{l_2}{\pi}$$

Scale $h\,o$ and $h\,n$ and multiply them by the diametral pitch number — 6. If the results are not whole numbers, as they usually are not, select the nearest whole numbers having the desired speed ratio, and they are the final numbers of teeth. Divide these numbers by the diametral pitch number to obtain the final values of $\frac{l_1}{\pi}$ and $\frac{l_2}{\pi}$ and lay them down as $h\,o'$ and $h\,n'$. Draw $o'\,k'$ and $l'\,n'$ and $k'\,a'$ and $l'\,b'$, giving:

$a'\,h =$ the final d_1,

$b'\,h =$ the final d_2,

$a'\,b' =$ twice the new center distance.

(Concluded next week.)

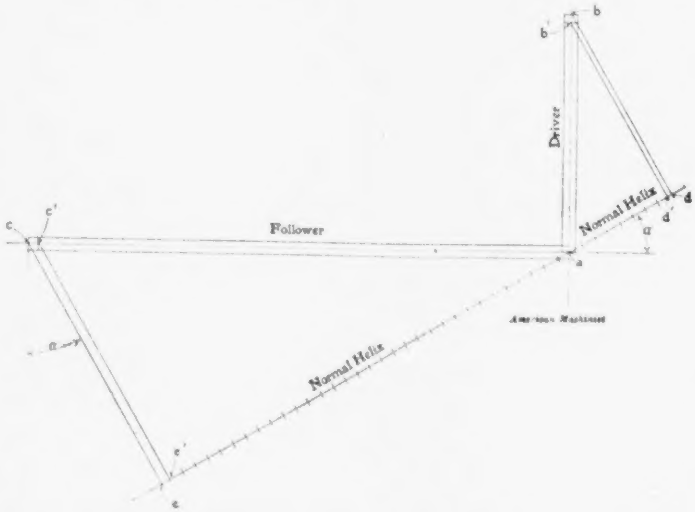


FIG. 10. ADJUSTING THE DIAMETERS WHEN THE CENTER DISTANCE CAN BE CHANGED.

*Should the helixes come out a little short instead of a little long, they would be lengthened instead of shortened. Had the helix of the driver been of a length to contain, say, 8.3 teeth, that of the follower would obviously have contained 33.2 teeth, and, in the correction, more than an entire tooth would have been cut from it.

*Had $c\,d$ been taken shorter than $a\,b$, g would have fallen to the left of the diagram, but the construction would otherwise have been unchanged.

Spiral Gears—III.

BY F. A. HALSEY.

FINAL SOLUTION WITH UNCHANGED CENTER DISTANCE.

If the center distance cannot be varied, the condition of things is shown in Fig. 12. Having found that the provisional normal helixes will not contain an exact number of teeth, and cut them off and obtained the smaller circumferences $a\,b'$ and

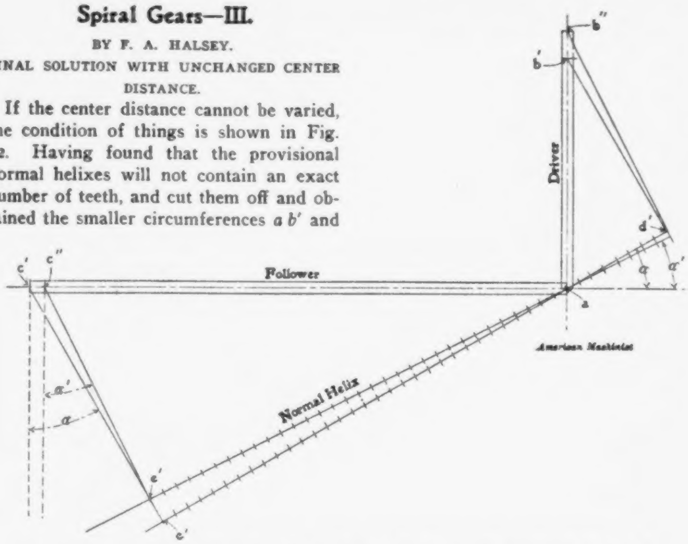


FIG. 12. ADJUSTING THE DIAMETERS WHEN THE CENTER DISTANCE IS FIXED.

$a\,c'$ of Fig. 10, the problem becomes to find a new value of α, indicated in Fig. 12, as α' which shall give such diameters as to restore the old center distance. That is, $ab'' + ac''$ of Fig. 12 must be equal to the original $a\,b + a\,c$ of Fig. 10. It will be seen by a glance at Fig. 12 that the reduced value of α increases the diameter of the driver, but reduces that of the follower.

It is probable that the correct angle and diameters for this case can be found only by trial. From (4) we have:

$$d_1 = \frac{l_1}{\pi \sin. \alpha} \qquad (7)$$

and from (5)

$$d_2 = \frac{l_2}{\pi \cos. \alpha} \qquad (8)$$

We also have:

$$d_1 + d_2 = 2\,C;$$

that is

$$\frac{l_1}{\pi \sin. \alpha} + \frac{l_2}{\pi \cos. \alpha} = 2\,C,$$

which easily reduces to:

$$1 + \frac{l_2}{l_1} \tan. \alpha = \frac{2\,C}{\frac{l_1}{\pi}} \sin. \alpha \qquad (9)$$

To solve this equation we know that $\frac{l_2}{l_1}$ = the speed ratio = 4 and in the preceding article we found that final $\frac{l_1}{\pi}$ = 1.333. Substituting these values and the value of C, the only unknown quantity is α, but, from the form of the equation, α can be found only by trial and error, the result of each trial being a closer and closer approximation to the truth. The operation is simple enough, but it involves the repeated multiplication of decimals. For the earlier steps a slide rule will greatly abbreviate the work, while with a Sexton's omnimeter an accuracy can be obtained sufficient for all the steps and a piece of drudgery be converted into an exhilarating chase. The results which follow were obtained with an omnimeter. Trying the provisional angle of 30 degrees in order to note the result and making the substitutions in (9) we obtain:

$$1 + 4 \times .577 = 6.702 \times .5$$

or

$$3.308 = 3.351.$$

This is not correct, as we knew it would not be. The right-hand number is larger than the left-hand number, which will always be the case if our trial value of α is too large, and *vice versa* if it is too small. Trying 28 degrees we obtain:

$$1 + 4 \times .532 = 6.702 \times .469$$

or

$$3.13 = 3.145.$$

The right-hand number is still too large, showing 28 degrees to be too large. Trying 26 degrees we obtain:

$$1 + 4 \times .488 = 6.702 \times .438$$

or

$$2.953 = 2.935.$$

The right-hand number is now too small, showing that 26 degrees is too small. Trying 26 degrees 30 minutes we obtain:

$$1 + 4 \times .499 = 6.702 \times .446$$

or

$$3. = 2.99$$

This angle is still too small, though obviously very nearly correct. Trying 26 degrees and 40 minutes we obtain:

$$1 + 4 \times .502 = 6.702 \times .449$$

or

$$3.01 = 3.01.$$

Within the limits of accuracy of the omnimeter this is correct, and as that instrument shows the effect of so small a change in the angle as 10 minutes the result is obviously close enough. It agrees with Mr. De Leeuw's determination. Having found the angle we are now in shape to find the final diameters. Substituting in (7) and (8) we obtain:

$$d_1 = \frac{1.333}{.4488} = 2.971$$

and

$$d_2 = \frac{5.333}{.8936} = 5.968$$

and $5.968 + 2.971 = 8.939$, which is twice the required center distance as closely as can be expected.

GRAPHICAL SOLUTION WITH UNCHANGED CENTER DISTANCE.

These determinations may also be made graphically, as shown in Fig. 13, which repeats the construction of Fig. 11 up to the finding of the provisional values of $a\,h$ and $b\,h$.

In Fig. 11 h is a fixed point, while a and b were not. In the present case a

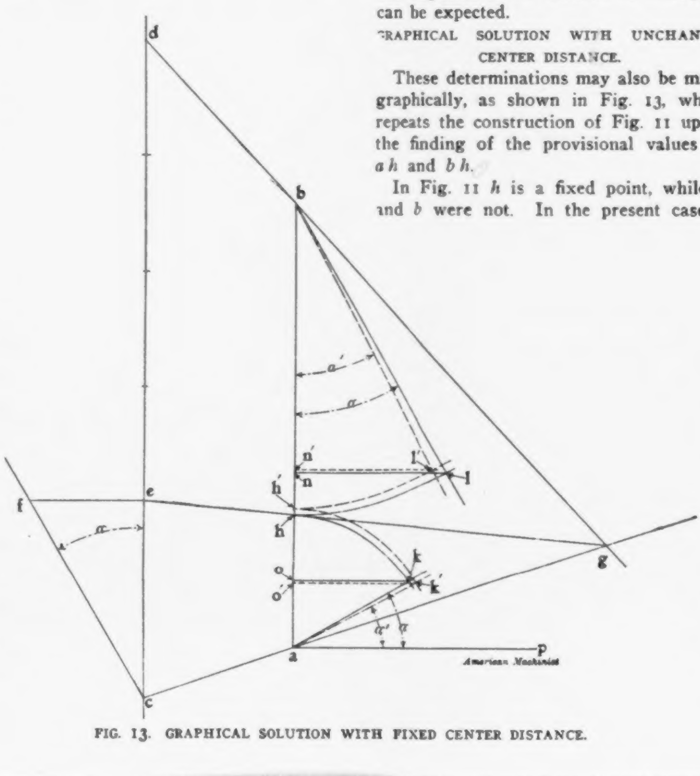


FIG. 13. GRAPHICAL SOLUTION WITH FIXED CENTER DISTANCE.

and b are fixed, but h is not, and to find $\frac{l_1}{\pi}$ and $\frac{l_2}{\pi}$ in the present case it is better to lay off α at a and b instead of at h, as was done in Fig. 11. Therefore lay down α at a and b, as shown, and strike arcs

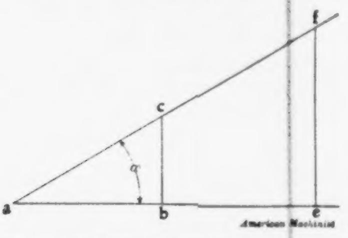


FIG. 14. FINDING THE PITCH OF THE TOOTH HELIX.

$h k$ and $h l$. Draw $k o$ and $l n$, giving the provisional values:

$$a o = \frac{l_1}{\pi}$$

$$b n = \frac{l_2}{\pi}$$

Measure these distances and multiply them by the diametral pitch number—in this case 6—to find the numbers of teeth going with the assumed value of α. If, as is usually the case, the products are not whole numbers, take the nearest whole numbers having the ratio of the desired speeds, divide them by the diametral pitch number and obtain the corrected values of $\frac{l_1}{\pi}$ and $\frac{l_2}{\pi}$. Lay off $a o'$ and $b n'$ equal to these corrected values. Assume a new trial angle, indicated as α', and lay it down at a and b. Draw $o' k'$ and $n' l'$, and through the intersections k' and l' dr w the dotted arcs. If these arcs meet in tangency at h', then we have the final values:

$$a h' = d_1$$

and

$$b h' = d_2.$$

If the arcs do not thus meet in tangency, assume another value for α and try again.

Graphical methods are sufficiently accurate for many purposes, especially if laid out upon an enlarged scale, and if it is remembered that if the values used for $\frac{l_1}{\pi}$ and $\frac{l_2}{\pi}$ are a little short of the true values, the shortage will be divided among the teeth with the only result of a little slackness in the teeth.

FINDING THE PITCH OF THE TOOTH HELIX.

It now only remains to find the pitch of the tooth helixes in order to set up the machine. In Fig. 9 let

p_1 = pitch of tooth helix of driver,

p_2 = pitch of tooth helix of follower;

then

$$p_1 = c_1 \tan. \alpha, \quad = \pi d_1 \tan. \alpha,$$

and

$$p_2 = c_2 \cot. \alpha, \quad = \pi d_2 \cot. \alpha.$$

Inserting the final values of d_1 d_2 and α we obtain:

$$p_1 = \pi \times 2.971 \times .502, \quad = 4.684,$$

and

$$p_2 = \pi \times 5.968 \times 1.991, \quad = 37.33.$$

These values may be found graphically as in Fig. 14. Lay down α and make $a b = \pi d_1$ when $b c = p_1$. Find $e f = \pi d_2$ and $a e = p_2$.

SPECIAL SOLUTION FOR A HELIX ANGLE OF 45 DEGREES.

Remembering that $\frac{l_2}{l_1} = \frac{r_1}{r_2}$, the latter fraction may be substituted for the former in (9) together with the assumed value of α and the provisional value of $\frac{l_1}{\pi}$ be thus found without first finding the provisional values of d_1 and d_2. The final values of d_1 and d_2 may then be found from (7) and (8). Such a solution is in some respects neater than the one given, but it is believed to be less easily followed and comprehended, and, moreover, it does not, for the general case, furnish the basis of so good a graphical solution. This method is at its best in the case of a helix angle of 45 degrees and the fact that, for this case, tan. α in (9) becomes 1 makes that equation the basis of a neat graphical solution for this special case. This angle does not differ from any other in requiring a change in the center distance if it is to be adhered to. In the nature of the case, if we deny ourselves the liberty of changing the angle, the only recourse is to correct length of the helix by changing the diameters. As this angle is used more than any other—perhaps more than all others—this solution for it is given.

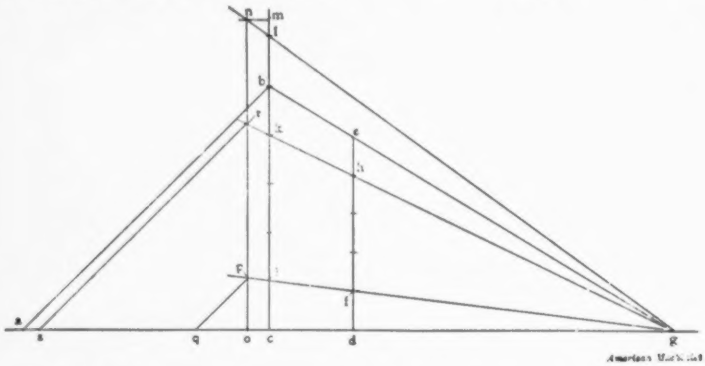


FIG. 15. SPECIAL GRAPHICAL CONSTRUCTION FOR A HELIX ANGLE OF 45 DEGREES.

Remembering that in (9) $\frac{l_2}{l_1} = \frac{r_1}{r_2}$, that tan. 45° = 1 and that sin. 45° = .7071, that equation becomes *for this angle only:*

$$1 + \frac{r_1}{r_2} = \frac{1.4142\,C}{\frac{l_1}{\pi}}$$

which may be made to read:

$$\frac{l_1}{\pi} = \frac{1.4142\,C}{1 + \frac{r_1}{r_2}} \qquad (10)$$

Inserting sin. 45° = .7071 in (7) we have:

$$d_1 = \frac{\frac{l_1}{\pi}}{.7071} \qquad (11)$$

Equations (10) and (11) are all that are needed for solving any case having this helix angle.

Taking up Mr. De Leeuw's problem again and solving it for this angle, we have from (10) for the provisional value:

$$\frac{l_1}{\pi} = \frac{1.4142 \times 4.468}{1 + 4}$$
$$= 1.2637.$$

Multiplying this by the diametral pitch of the cutter to be used, we obtain:

$$1.2637 \times 6 = 7.58$$

as the provisional number of teeth in the driver. As it is an impossible number, we select 8 as the number of teeth and, dividing it by 6, we obtain:

$$\frac{8}{6} = 1.333$$

as the final value of $\frac{l_1}{\pi}$. Substituting this in (11), we obtain:

$$d_1 = \frac{1.333}{.7071}$$
$$= 1.885$$

as the final value of the diameter of the driver. The diameter and number of teeth of the follower for an angle of 45 degrees are found by multiplying the diameter and number of teeth of the driver by the speed ratio. That is:

$$d_2 = 1.885 \times 4$$
$$= 7.540$$

and

number of teeth in follower $= 8 \times 4 = 32$

Finally

$$d_1 + d_2 = 1.885 + 7.54$$
$$= 9.425$$

= twice the final center distance.

GRAPHICAL SOLUTION FOR AN ANGLE OF 45 DEGREES.

The special graphical solution for this case is given in Fig. 15:

Lay down the base line and at a lay off $a b$ at an angle to it of 45 degrees. Make $a b = 2C$—in this case $8\frac{15}{16}$ inches—and draw the perpendicular $b c$. At any convenient point draw the perpendicular $d e$,

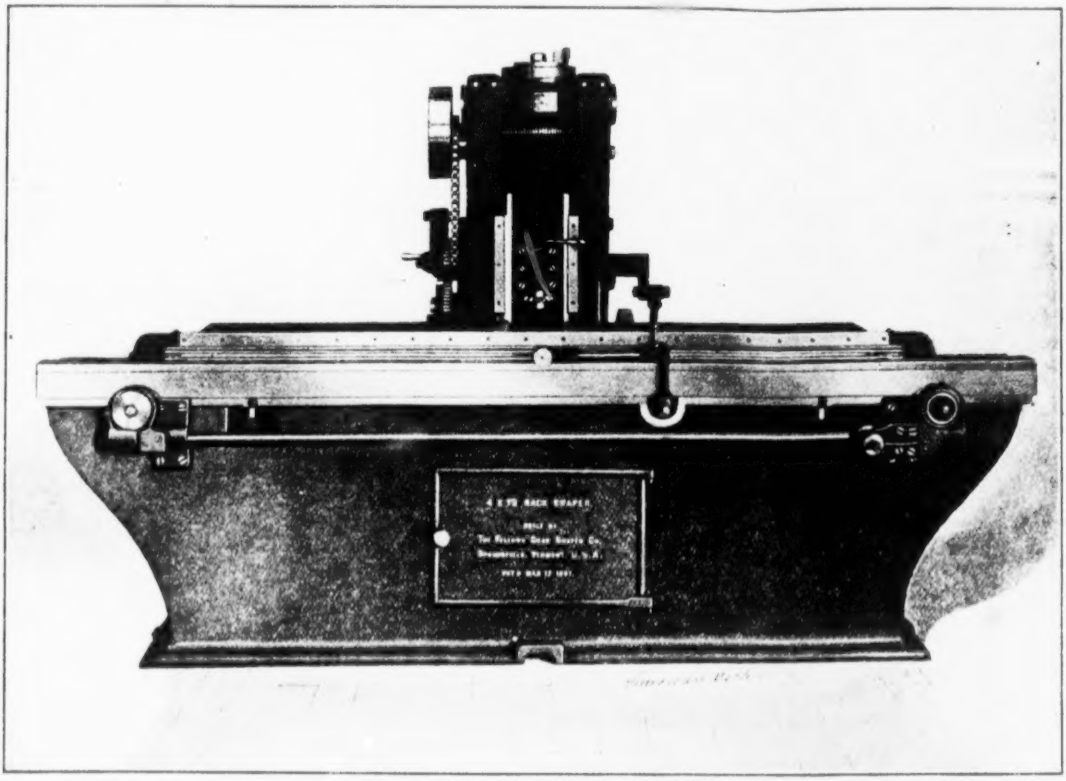


FIG. 1. FRONT VIEW OF FELLOWS RACK SHAPER.

making $d f = 1$ inch and $f e$ as long in inches as will represent the speed ratio; that is, in the present case, make $f e = 4$ inches. Draw $b c$ and extend it till it meets the base line at g. Draw $f g$ through the first inch from d and $h g$ through the fourth inch, giving:

$$c\ i = \text{the provisional value of } \frac{l_1}{\pi}$$

and

$$c\ k = \text{the provisional value of } \frac{l_2}{\pi}$$

Step off $c\ i$ from c as many times as will represent the diametral pitch number—in this case 6—giving l. Measure $c\ l$, which in inches gives the provisional number of teeth in the driver. If not a whole number of inches in length, as it usually is not, locate m such that $c\ m$ equals the nearest whole number of inches—in this case 8, which is the final number of teeth in the driver. Draw $g\ l$, $m\ n$, $n\ o$, $p\ q$ and $r\ s$, and we have:

$$o\ p = \text{final } \frac{l_1}{\pi},$$

$$o\ r = \text{final } \frac{l_2}{\pi},$$

$$p\ q = \text{final } d_1.$$

$$r\ s = \text{final } d_2.$$

$$p\ q + r\ s = \text{twice the final center distance.}$$

The number of teeth in the follower equals those in the driver multiplied by the speed ratio.

(*Conclusion.*)

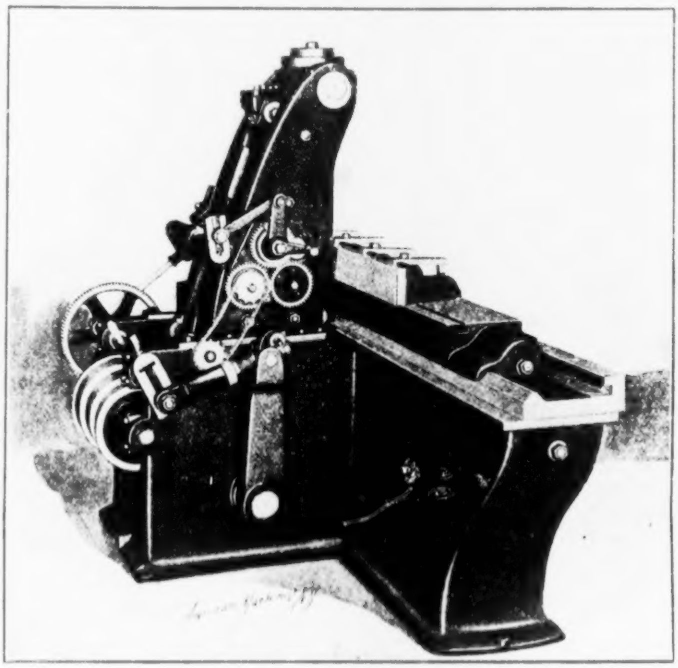
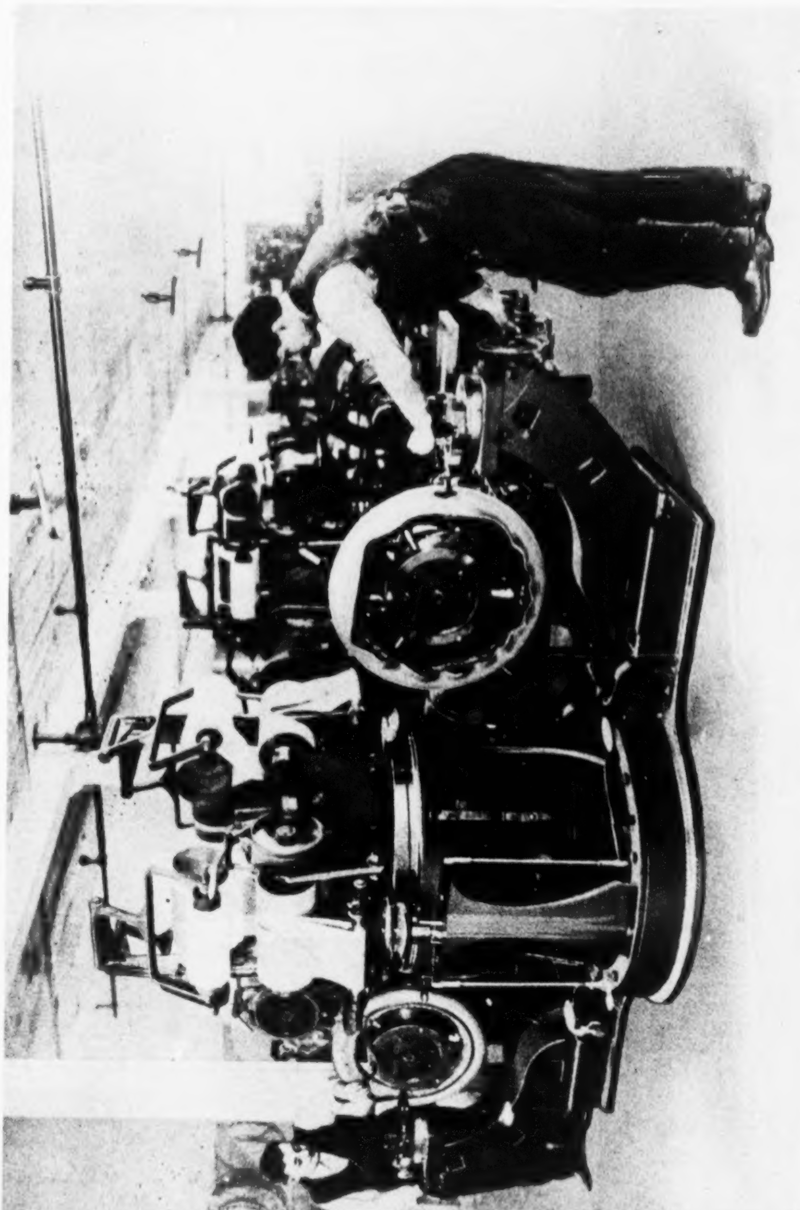


FIG. 2. END VIEW OF RACK SHAPER.

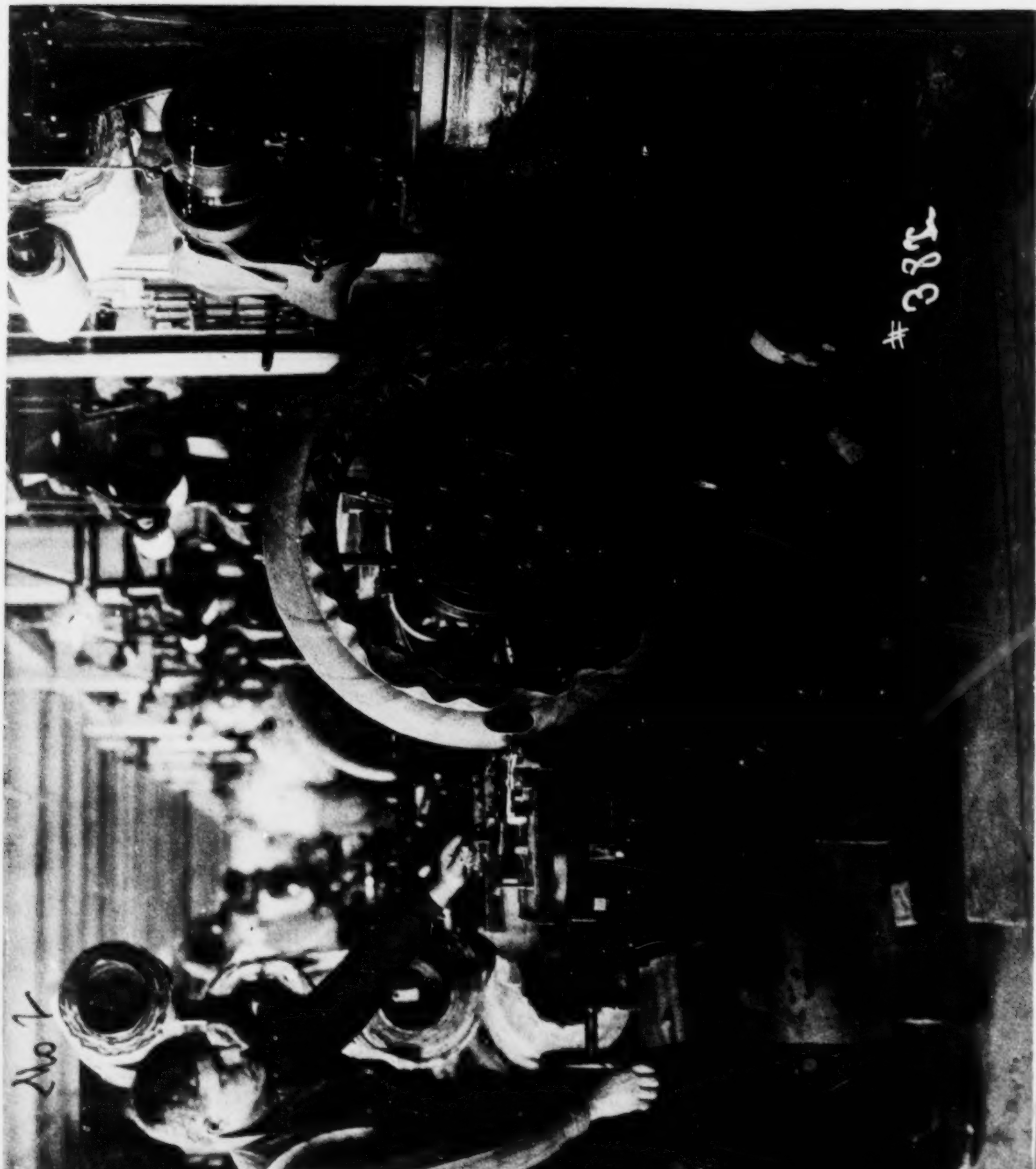
Plaintiff's Exhibit No. 35—Photographs State Machines.

(No. 1.)



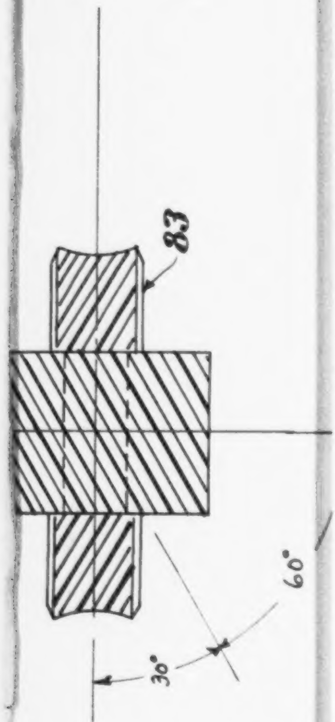
Plaintiff's Exhibit No. 35—Photographs State Machines.

(No. 2.)



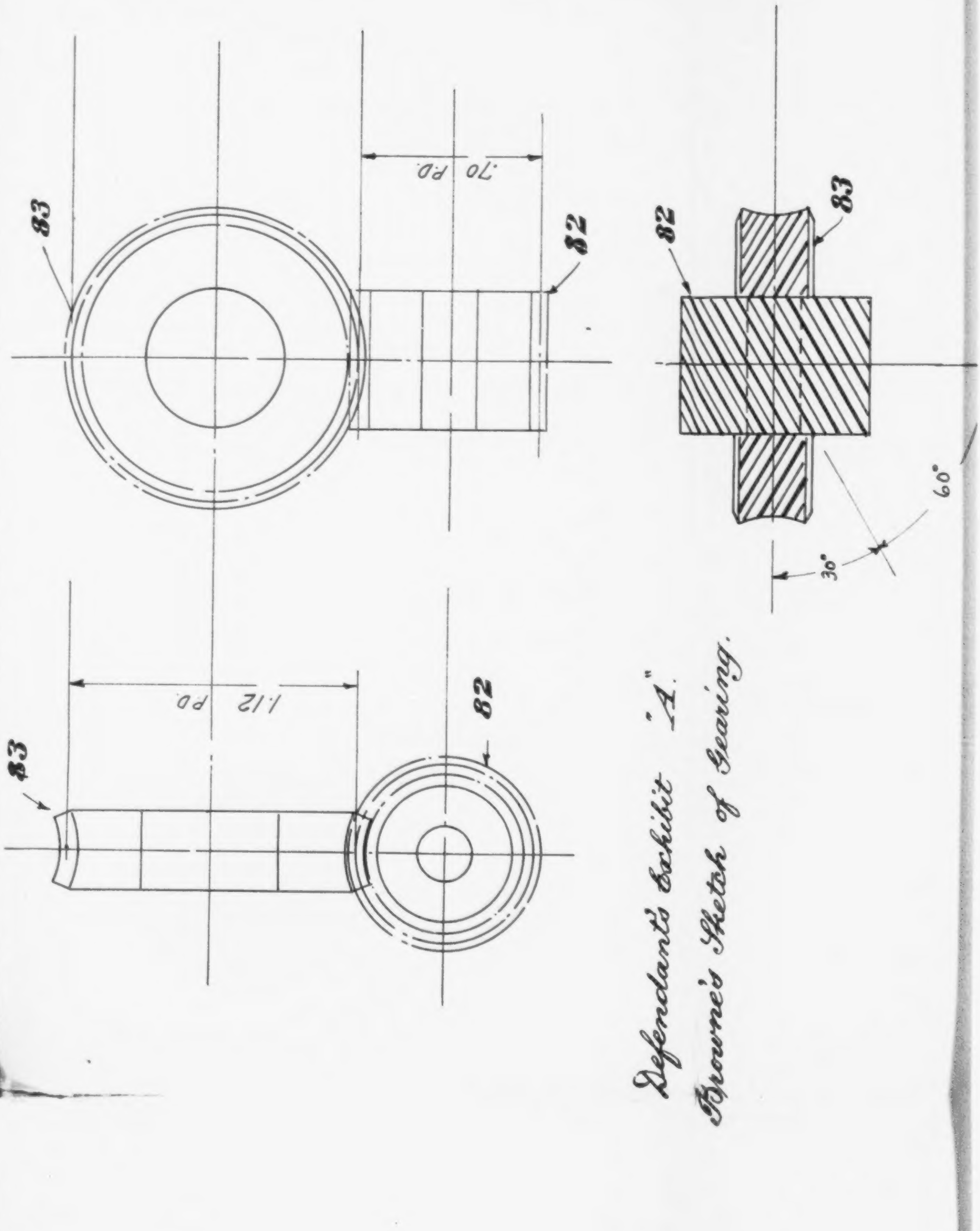
DEFENDANT'S EXHIBITS.

Gearing.



Browne's Sketch of Gearing.

Defendant's Exhibit A—Browne's Sketch of Gearing.



Defendant's Exhibit F—Mathern Belgian Patent.

UNITED STATES CIRCUIT COURT OF APPEALS

FOR THE SIXTH CIRCUIT.

WILLIAM C. COCHRAN.

I, [redacted]*, Clerk of the United States Circuit Court of Appeals for the Sixth Circuit, do hereby certify that the foregoing is a true and correct copy of* the original certification of the Belgian Patent to Mathern, No. 194,731, as filed December 5th,1917 *in the case of* The Firestone Tire & Rubber Company

vs.

Frank A. Seiberling

No. 2954, and, *as the same remains upon the files and records of said United States Circuit Court of Appeals for the Sixth Circuit, and of the whole thereof.*

IN TESTIMONY WHEREOF, I have hereunto subscribed my name, and affixed the seal of said Court, at the City of Cincinnati, Ohio, this 21st *day of* December *A. D. 19*17

William C. Cochran

Clerk of the United States Circuit Court of Appeals for the Sixth Circuit.

No. 7791

UNITED STATES OF AMERICA.

DEPARTMENT OF STATE.

To all to whom these presents shall come, Greeting:

I Certify That Mr E. de Cartier de Marchienne whose name is subscribed to the paper hereto annexed, is duly accredited to this Government as Envoy Extraordinary and Minister Plenipotentiary of Belgium.*

In testimony whereof I, Robert Lansing Secretary of State, have hereunto caused the Seal of the Department of State to be affixed and my name subscribed by the Chief Clerk of the said Department, at the City of Washington, this 25th day of July, 1917.

Robert Lansing
Secretary of State.

By Ben G. Davis
Chief Clerk.

*FOR THE CONTENTS OF THE ANNEXED DOCUMENT THE DEPARTMENT ASSUMES NO RESPONSIBILITY.

MINISTERE
DE
L'INDUSTRIE ET DU TRAVAIL.

ADMINISTRATION
DE
L'INDUSTRIE.

Service de la Propriété industrielle.

N° 194731

Vu le Secrétaire Général du Ministère de l'Industrie et du Travail de Belgique apposé ci-contre.
Washington D.C. le 25 juillet mil neuf cent dix
[illegible] le Ministre de Belgique
Ed. de Cartier

Royaume de Belgique

L'UNION FAIT LA FORCE

BREVET D'INVENTION

LE MINISTRE DE L'INDUSTRIE ET DU TRAVAIL,

Vu la loi du 24 mai 1854;

Vu le procès-verbal dressé le 20 Septembre 1906 *à* 12 *h.* 55'
au Greffe du Gouvernement provincial du Brabant;

ARRÊTE :

Article 1er. — *Il est délivré à M.* A. Mathern,
à Bruxelles, rue Plantin, 13,
repté par M. Noël, à Bruxelles,

un brevet d'invention
pour : Machine et procédé pour fabriquer mécaniquement les enveloppes pour bandages pneumatiques.

Article 2. — *Ce brevet lui est délivré sans examen préalable, à ses risques et périls, sans garantie soit de la réalité, de la nouveauté ou du mérite de l'invention, soit de l'exactitude de la description, et sans préjudice du droit des tiers.*

Au présent arrêté demeurera joint un des doubles de la spécification de l'invention (mémoire descriptif et dessins) signés par l'intéressé et déposés à l'appui de sa demande de brevet.

Bruxelles, le 29 Septembre 1906.

Pour le Ministre et par délégation :
LE DIRECTEUR GÉNÉRAL,
(s.) A. Anciaux
Pour copie conforme :
Le Directeur délégué,
[illegible]

COPIE CONFORME
Le Directeur délégué
F. Bastenier

Coût: Arrêté: Fr
Texte: -
Dessin: - 1, -

GESEHEN
Im Auftrage des Generalreferenten

M E M O I R E   D E S C R I P T I F
déposé à l'appui d'une demande de
B R E V E T   D ' I N V E N T I O N
formée par
Monsieur Alphonse M A T H E R N E, Ingénieur,
13, rue Plantin à Bruxelles.
pour:
MACHINE ET PROCEDE POUR FABRIQUER MECANIQUEMENT LES ENVELOPPES POUR BANDAGES PNEUMATIQUES.

L'invention a pour objet une machine et un procédé pour fabriquer mécaniquement les enveloppes pour bandages peumatiques.

Le but de la machine est: de permettre la pose de toiles superposées sur un noyau leur donnant la forme et la tension rigoureusement exactes et régulières;le rognage après ou avant la pose des toiles,dans des conditions d'exactitude rigoureuse; la mise en place rigoureusement exacte des talons;l'application de la couche extérieure de caoutchouc;toutes ces opérations s'exécutant mécaniquement,avec la plus grande précision et la plus parfaite uniformité,quelles que soient les dimensions des bandages,dans tous les sens.

La machine,objet de la présente demande de brevet,est représentée au dessin annexé dans lequel:

La fig.I est une vue en élévation,la fig.2 une vue en plan, et la fig.3 une coupe par la ligne A B de la fig.2.

Les figs. 4 à 5 montrent en élévation et en plan,l'outil à rogner les toiles.

La fig.6 représente l'outil à molette pour effectuer le déplissage.

Les figs.7,8 et 9 représentent en élévation,plan & profil respectivement l'outil pour la pose des talons.

Les figs.IO & II montrent en élévation et en coupe l'outil pour l'application des bandes de gomme.

La machine est constituée d'une manière générale comme suit:

Un bâti rectangulaire creux en fonte 1 reçoit deux montants latéraux 2.Ces montants latéraux comportent des mamelons et des glissières pour recevoir les arbres et paliers formant partie du mécanisme.

Le cône à trois vitesses 3 accolé au petit pignon 4 commande la roue 5 qui par le pignon transmet le mouvement à la roue 7 calée sur l'arbre II qui,par le pignon 8 commande la roue 9 qui actionne alors l'arbre I2 sur lequel se trouve fixé le noyau devant recevoir les toiles.Ce noyau IO tourne alors à la vitesse suffisante pour l'enroulement des toiles,la pose des talons,des bandes de gomme,etc..

Le cône 3 est fou sur son arbre mais peut en être rendu solidaire par un embrayage à griffe logé à l'intérieur.Les engrenages 5 et 6 étant montés sur un arbre I3 excentré dans ses portées,on peut les écarter à volonté au moyen de la poignée I4.Ceci étant fait et le cône étant embrayé avec son arbre,le pignon 8 calé sur celui-ci,commande alors directement l'arbre I2 par la roue 9 et on a alors pour le noyau IO la vitesse nécessaire pour déplisser les toiles sur le noyau,pour rogner ces toiles,pour moleter la carcasse finie,etc..

L'arbre I2 comporte un débrayage à griffe I5 permettant de rendre l'arbre I2 indépendant de la roue 9;l'arbre tourne alors fou et on peut faire tourner le noyau à la main dans un sens quelconque,cela pour vérifier le travail ou pour nettoyer les toiles,etc..Sur l'arbre I2 se trouve montée une pièce à coulisse I6 dans laquelle se meut dans le sens de la hauteur

un coulisseau 17 formant porte-outil et destiné à recevoir les outils nécessaires pour le travail à exécuter.

La toile s'enroule sur un tambour en bois 18 muni de guides latéraux mobiles 19 pour les différentes largeurs des toiles employées;ce tambour en bois est monté sur un arbre carré en cet endroit,mais rond sur le reste de sa longueur.Cet arbre 20 reçoit un tambour 21 sur lequel s'enroulent des lames d'acier tirées d'une part par la vis 22 et le volant 23 et maintenues d'autre part par une tension à ressort 24.

L'arbre 20 peut être avancé ou reculé à volonté selon les diamètres des bandages à confectionner.Pour cela,cet arbre est monté sur deux paliers 25 pouvant se glisser à volonté en avant et en arrière sur les coulisses ménagées dans les bâtis latéraux 2.

La pose des différentes toiles sur le noyau est assurée de la façon suivante:

L'arbre 20 supporté par deux paliers 25 montés sur les coulisses des bâtis latéraux 2,porte un tambour en bois 18 cylindrique ou bombé,sur lequel on enroule les toiles.Les deux bagues 19 montées sur ce tambour 18 assurent l'enroulement exactement en son milieu.La toile,en quittant le cylindre,passe entre deux galets sphériques ou ovoïdes,disposés de façon à produire un léger allongement sur le milieu de la toile,allongement facilitant de beaucoup le déplissage.Sur le même support il est monté de chaque côté,deux engrenages côniques 26 dont le seul but est de produire un léger plissement régulier des toiles sur leur bord,assurant à l'avance,un retrait régulier de la toile en tous ses endroits.De là,la toile est posée sur le noyau,enduit d'une couche de dissolution de caoutchouc, de façon à ce que la toile y adhère bien et soit entraînée par son mouvement de rotation.

Le tambour en bois 18 est retenu dans son mouvement de rotation par le frein métallique à lames d'acier,agissant sur le tambour en fonte 21.En mettant en rotation le volant 23,on exerce une traction sur les lames du tambour 21;ces lames sont

retenues à leur extrémité,par un ressort 24 dont la tension est proportionnelle au serrage donné par le volant 23 sur la vis 22,cette tension étant calculée pour les efforts à exercer sur les toiles.On a pour celles-ci une résistance au déroulement parfaitement régulière et plus ou moins forte à volonté, selon les profils que l'on exécute à la machine.

La toile étant entraînée et déroulée du tambour 28,elle vient rencontrer les molettes 30 de la boîte 28.Cette boîte 28 renferme un arbre vertical coudé 33 qui actionne un coulisseau 32 guidé dans les parois de la boîte 28.Ce coulisseau 32 porte deux bielles 31 à deux articulations.Ces bielles portent chacune à leur extrémité une molette 30 qui avance et recule sur le noyau de façon à appliquer contre ses flancs droits ou bombés la toile qui vient d'y être placée.Lorsque le noyau a fait un tour complet en passant par ces molettes,on recule la boîte 28 qui s'écarte sur la glissière 34.On change alors la vitesse de la machine en embrayant le cône 3 avec l'arbre 11 et en écartant les engrenages 5 et 6.Sur le support 17 formant porte-outil,on monte un outil suivant la fig.6 portant une chape avec une molette à angle arrondi.On monte le coulisseau porte-outil 17 de façon que la molette arrive au niveau du dessus du noyau. On met alors la machine en mouvement et on descend la molette progressivement sur le flanc du noyau jusqu'à la base:on obtient ainsi le déplissage complet et rapide de la toile,le mouvement de descente se faisant automatiquement par l'avance ou cliquet 34.On peut aisément faire les deux côtés d'un seul coup. en montant deux outils suivant la fig.6 sur le coulisseau porte-outil 17.La toile étant ainsi posée par ces moyens,on procède de la même façon à la pose des diverses toiles sur lesquelles on applique les talons,ensuite,quand les talons sont posés, on procède à la pose des autres toiles devant recouvrir et envelopper les talons.La pose de ces autres toiles,s'effectue de la même façon,au moyen des molettes 30 et des outils à molettes suivant la fig.6.Ce dernier dispositif a le grand avantage,

étant commandé à main,de pouvoir contourner facilement les talons.On peut alors mettre dans les chapes,des molettes avec un bord arrondi plus mince,pour bien serrer et coller les toiles dans le fond des talons.

Les systèmes de commande des divers mécanismes pourront être différents de ce qui est décrit ci-dessus,mais l'invention comprend l'application à la fabrication des bandages (a) du principe des deux galets 26 et des deux engrenages latéraux préparant la toile;(b) du principe des molettes 30 avançant et reculant en appuyant sur le noyau dans le sens du rayon pour coller la toile sur ses flancs.(c) du principe de la molette descendant sur le noyau progressivement en rotation rapide,produisant le déplissement progressif de la toile,en enlevant les plis dès leur naissance,cela en un seul mouvement de descente.

Pour l'application de ces deux derniers principes,les molettes peuvent être placées en un point quelconque du noyau, l'essentiel étant que leur mouvement se fasse comme il est expliqué.

Pour la pose des talons,on emploi un jeu de deux molettes, suivant le croquis fig.7.L'âme du talon étant en A une molette principale inclinée,vient prendre le talon en dessous et une autre plus petite,formant maintient,vient se poser dessus en appuyant avec la poignée D;en mettant ensuite le bout du talon dans les deux molettes B et C,ce talon se colle sur la toile par une faible pression de la main;de plus,pour assurer une pose rigoureusement juste le jeu de molettes de cet outil comporte de chaque côté,un guide d'entrée percé de trous G ayant la forme des talons à poser et les préparant pour l'inclinaison à leur donner;on en met un de chaque côté,pour servir pour les deux côtés du noyau;mais on peut faire un jeu de molettes avec guide pour chaque côté.

Après avoir engagé le talon dans le trou du guide de derrière,les deux molettes en appuyant l'outil sur le noyau,celui-ci,par son mouvement de rotation,entraîne le talon qui passe

dans son guide, vient se placer de ce fait sous les molettes et se trouve rigoureusement et rapidement posé.

Lorsque les talons sont posés, on procède alors à la pose des toiles qui doivent recouvrir les talons; on procède alors comme il a été dit et avec les outillages décrits ci-dessus.

Après que ces dernières toiles sont posées, on procède alors au rognage de ces diverses toiles adhérentes au noyau mais irrégulières à leur base; pour cela on se sert d'un outil suivant la fig.4. Cet outil est composé d'un support A se fixant par le trou B sur le porte-outil I7, par l'intermédiaire des goujons 35, à l'extrémité de l'outil.

Sur la partie repliée d'équerre, vient se fixer un levier à main C pivotant autour d'un axe et comportant à son extrémité une lame tranchante pouvant être démontée assez facilement; on monte cet outil de façon qu'en tournant le levier, la lame vienne rencontrer le noyau; la position en hauteur, se règle aussi facilement au moyen du coulisseau I7, mobile en hauteur.

En rencontrant le noyau, la lame rencontre aussi les toiles à couper et comme ce noyau est animé d'un mouvement de rotation assez rapide, cette coupe s'effectue instantanément.

L'opération restant à effectuer, consiste dans la pose des bandes de gomme, qui se fait au moyen d'un jeu de molettes spéciales, suivant la fig.IO. Ce jeu de molettes est monté sur une plaque C maintenue par un axe vertical glissant dans une douille D fixée sur le coulisseau I7 dans son milieu. Cette disposition des molettes a pour but de coller d'abord le milieu et ensuite les côtés, pour être bien certain d'un collage parfait. L'ensemble étant appuyé sur le noyau par un ressort, la molette A prend la bande de gomme laminée et enroulée sur le tambour I8 après qu'on a enlevé le jeu de galets 26. Par le mouvement de rotation du noyau dans le sens de la flèche, la bande se pose sur le noyau; après avoir quitté la molette A, la bande est prise sur ses côtés par les molettes B qui achèvent de la coller. Le mouvement la déroule alors du tambour, pour la placer sur le noyau.

La fabrication du bandage est alors terminée et il n'y a plus qu'à le préparer pour le moulage.

REVENDICATIONS.

1°-Dans une machine pour fabriquer mécaniquement les enveloppes pour bandages pneumatiques,caractérisée par ce que divers engrenages et embrayages transmettent à un noyau circulaire divers mouvements de rotation appropriés aux phases de la fabrication et permettant l'emploi des dispositifs spéciaux faisant partie de la machine,en substance comme décrit et représenté au dessin annexé.

2°-Dans la machine pour fabriquer mécaniquement les enveloppes pour bandages pneumatiques,comme revendiqué en 1°,un jeu d'engrenages et de galets sphériques pour produire un allongement et un retreint régulier de la toile,en facilitant le collage contre le noyau,en substance comme décrit.

3°-Dans une machine pour fabriquer mécaniquement les enveloppes pour bandages pneumatiques,comme revendiqué en 1°,un dispositif consistant en un ou plusieurs jeux de molettes portées par un chariot recevant par l'intermédiaire d'un levier coudé,un mouvement alternatif perpendiculaire à l'axe du noyau pour appliquer les toiles contre les flancs du noyau en substance et comme décrit.

4°-Dans une machine pour fabriquer mécaniquement les enveloppes pour bandages pneumatiques,comme revendiqué en 1°,un porte-outil à molettes à descente progressive et automatique, dépendant de la rotation du noyau,pour effacer progressivement les plis des bandes successives de toile et pour fixer ces bandes sur les talons,en substance comme décrit et représenté au dessin annexé.

5°-Dans une machine pour fabriquer mécaniquement les enveloppes pour bandages pneumatiques,comme décrit en 1°,un jeu de deux molettes agissant par la pression d'un levier commandé à main,pour coller les talons;un guide d'entrée approprié étant

prévu devant les molettes pour assurer une mise en place rigoureusement exacte des talons,en substance comme décrit et représenté au dessin annexé.

6°-Dans une machine pour fabriquer mécaniquement les enveloppes pour bandages pneumatiques,comme revendiqué en 1°,un dispositif pour rogner les toiles lorsqu'elles sont mises en place,ce dispositif consistant en un levier à main,se fixant au porte-outil de la machine et portant une lame,de manière qu'une pression de la main sur le levier produise la coupe des toiles.

7°-Dans une machine pour fabriquer mécaniquement les enveloppes pour bandages pneumatiques comme revendiqué en 1°,un jeu de trois galets,sous action de ressorts,venant coller d'abord au milieu,puis sur les bords,la bande de caoutchouc qui termine l'enveloppe.

8°-Le procédé de fabrication des enveloppes pour bandages peunmatiques par l'emploi de la machine et des dispositifs revendiqués de 1° à 7°,et comportant les opérations suivantes:a) enroulement des toiles sur le noyau;après allongement et rétreint préalable; b)application de la toile contre les flancs du noyau; c) enlèvement des plis formés; d) pose des talons;e) rognage des toiles; f) collage de la bande de caoutchouc,toutes ces opérations s'effectuant mécaniquement et pendant la rotation,a différentes vitesses,du noyau annulaire.

Bruxelles,le 20 Septembre 1906.

Par procuration de Mr A. MATHFRHE

(s.) G. N O E L.

Translation of Belgian Patent to Mathern, No. 194731. Sept. 20, 1906.

Specification filed in support of an application for patent on an invention made by Mr. Alphonse Matherne, Engineer, 13 Rue Plantin, Brussels, for MACHINE AND PROCESS FOR MECHANICALLY MANUFACTURING CASINGS FOR PNEUMATIC TIRES.

This invention has for its subject a machine and a process for mechanically manufacturing casings for pneumatic tires.

The object of the machine is:

To enable the placing of fabric strips in super-position on a core and giving them an absolutely exact form and an absolutely uniform tension;

To enable the trimming off after or before the placing of the fabric strips under conditions of absolute exactness;

To enable the absolutely exact positioning of the beads;

To enable the application of the outer layer of rubber;

All the foregoing operations being mechanically performed, with the greatest precision and most perfect uniformity, whatever may be the dimensions of the tires in any direction.

The machine which is the subject of the present application is represented in the attached drawing in which:

Fig. 1 is a view in elevation,

Fig. 2 a plan view, and

Fig. 3 a section on line A B of Fig. 2.

Figs. 4 and 5 show, in elevation and in plan, the tool for trimming the fabric strips.

Fig. 6 represents the roller tool for removing the puckers.

Figs. 7, 8 and 9 represent in elevation, plan and profile respectively, the tool for placing the beads.

Figs. 10 and 11 show, in elevation and in section, the tool for applying the strips of rubber.

In general the machine is constructed as follows:

An open rectangular cast iron frame 1 is provided with two side members 2. These members carry projections and slides for receiving shafts and bearings, which form part of the mechanism.

A three speed cone 3 which is fast to a small pinion 4 drives the wheel 5 that transmits, through the pinion, movement to the wheel 7 keyed on the shaft 11, which latter, through the pinion 8, drives the wheel 9 which itself actuates the shaft 12 on which the core is fixed before receiving the fabric strips. The core 10 under this condition rotates at a speed sufficient for winding on the strips of fabric, placing the beads, placing the rubber strips, etc.

The cone 3 is loose on its shaft, but can be fixed thereto by a jaw clutch located within it. The gears 5 and 6 are mounted on a shaft 13, which is eccentric in its bearings, thus they may be moved aside when desired by means of the handle 14. When this is done and the cone is clutched to its shaft, the pinion 8 keyed on the latter directly drives the shaft 12 through the wheel 9, and under this condition the core 10 has the speed which is necessary for removing the puckers from the fabric strips on the core, for trimming off these fabric strips, for rolling the finished carcass, etc.

The shaft 12 carries a releasing clutch 15, which enables the shaft 12 to be disengaged from the wheel 9; under this condition the shaft rotates freely and the core may be turned by hand in either direction in order to examine the work or to clean the fabric strips, etc. Over the shaft 12 a slide support 16 is mounted, in which there is located for movement in a vertical direction a

slide 17 which constitutes a tool carrier and is designed to receive the tools which are necessary for the work to be done.

The fabric is wound up on a wooden drum 18, which is provided with movable side guides 19, for different widths of fabric employed. This wooden drum is mounted on a shaft that is squared at this point but round throughout the remainder of its length. This shaft 20 carries a drum 21, which is embraced by steel bands that are pulled at one side by the screw 22 and wheel 23 and anchored at the other side by a spring tension 24.

The shaft 20 may be advanced or withdrawn at will according to the diameters of tires to be made. For this purpose, this shaft is mounted on two bearings 25, which may be slid at will forwardly or rearwardly on slides fashioned in the side members 2.

The placing of the several fabric strips on the core is accomplished in the following manner:

The shaft 20, supported by the two bearings 25 mounted on the slides of the side members 2, carries a wooden drum 18 that is cylindrical or convex, on which drum the fabric strips are wound. The two rings 19 mounted on this drum 18 ensure the winding up exactly on the middle of the drum. The fabric, on leaving the drum, passes between two rolls that are spherical or oval in form and arranged in such a manner as to produce a slight lengthening of the middle of the fabric, which lengthening greatly facilitates the removal of the puckers. On the same support there is mounted at each side two conical gears 36, the sole purpose of which is to produce a slight uniform puckering of the fabric strips at their edges, ensuring in advance a uniform contraction of the fabric at all points. Next the fabric is placed on the core, which is coated with a layer of rubber solution so that the fabric adheres well to it and may be pulled along by its rotary movement.

The wooden drum 18 is restrained in its rotary movement by the metallic brake consisting of the steel bands acting on the cast iron drum 21. By rotating the wheel 23, a drag is exerted on the bands of the drum 27, which bands are anchored at their ends by a spring 24 the tension of which is proportionate to the drag exerted by the wheel 23 on the screw 22, which tension is predetermined according to the pull to be exerted on the fabric strips. This provides for these latter, a tension against unrolling, which is perfectly uniform and stronger or weaker at will according to the profiles of tires being made on the machine.

As the fabric is pulled along and unwound from the drum 18 it encounters the rollers 30 on the casing 28. This casing 28 encloses a vertical bent shaft 33, which actuates a slide 32, that is guided in the walls of the casing 28. This slide 32 carries two rods 31 at two joints. Each of these rods carries at its extremity, a roller 30, which advances and retracts on the core, so as to stick to its straight or convex sides the fabric which has just been placed there. When the core has made a complete revolution, passing by these rollers, the casing 28, which moves away on the track 34, is retracted. Then the speed of the machine is changed by clutching the cone 3 to the shaft 11 and moving aside the gears 5 and 6. On the support 17, which constitutes a tool carrier, there is mounted a tool like that shown in Fig. 6, which has a fork with a rounded roller set at an angle. The sliding tool carrier 17 is adjusted so that the roller comes to the level of the top of the core. Then the machine is set in operation and the roller is caused to descend progressively on the side of the core and all the way down to its base. Thus there is obtained the complete and rapid removal from the fabric of the puckers, the descending motion being produced automatically by the pawl 34. Both sides may be readily worked at the same time, by

mounting two tools like that shown in Fig. 6 on the sliding tool carrier 17. After the fabric has been thus laid down by these devices, the same operation is repeated in laying down the several fabric strips on which the beads are applied; then, after the beads have been put on, the other fabric strips are laid down before covering and enclosing the beads. The laying down of these other fabric strips is accomplished in the same manner by means of the rollers 30 and the roller tools like that shown in Fig. 6. This last device has a great advantage in being manually controlled, whereby it has the capacity of easily passing over the beads. Thereafter, rollers with a narrower rounded edge may be placed in the forks in order to thoroughly press and stick the fabric strips on the bottom of the beads.

The control systems of the several mechanisms may differ from those described above, but the invention comprises the application to the manufacture of tires (*a*) of the principle of two rolls 26 and two side gears, which prepare the fabric (*b*) of the principle of rollers 30 advancing and retracting in a radial direction while bearing on the core for cementing the fabric on its sides (*c*) of the principle of the roller descending progressively on the core during rapid rotation and producing a progressive removal from the fabric of the puckers by eliminating the puckers from the point of their origin, this being performed in a single descending movement.

In carrying out these last two principles, the rollers may be placed at any desired point on the core, the essential thing being that their movement take place as explained.

For laying on the beads there is employed a set of two rollers, like the design of Fig. 7. The core of the bead being at A, a main inclined roller grips the bead below and another, smaller roller, constituting a holding means, is placed above by pressing with the handle D.

When the end of the bead is then placed between the tw rollers B and C, the bead may be stuck on the fabric by light pressure of the hand; further, in order to ensure a exactly accurate placement, the set of rollers of this too has, at each side, an entrance guide provided with hole G, which have the shape of the beads to be laid on an which prepare them for the angle at which they are to b set. One of these may be used for both sides in order t operate on two sides of the core; but a set of rollers wit guide may be provided for each side.

After inserting the bead in the guide hole from th rear, the two rollers are pressed by the tool against th core, and the latter, by its rotary movement, draws alon the bead which passes through its guide and thereby i caused to pass under the rollers and be accurately and rapidly laid on.

After the beads have been placed, the next proceedin is to lay on the fabric strips which are to cover the beads this step being carried out as has been described and with the tools described above.

After these last fabric strips have been laid on, the next proceeding is to trim off the fabric strips which are adhering to the core, but are irregular at their edges. In order to accomplish this, use is made of a tool like that shown in Fig. 4. This tool consists of a support A which is secured by a hole B to the tool carrier 17, through the employment of the pins 35, at the extremity of the tool.

On the right angle part, there is fixed a hand lever C, which pivots about an axis and carries at its end a cutting blade, which is readily removable. This tool is mounted in such a manner that by turning the lever, the blade will contact with the core; and its position as to height may be easily adjusted by means of the slide 17 that is vertically movable.

When it contacts with the core, the blade also contacts with the fabric strips to be cut and, as the core is

rotated at a sufficiently high speed, this cutting operation is instantly effected.

The operation which remains to be performed consists in the laying on of the strips of rubber, which is performed by means of a set of special rollers, as shown in Fig. 10. This set of rollers is mounted on a plate C, which is supported by a vertical axis which slides in a sleeve D, secured to the slide 17 at its center. This arrangement of rollers is designed to first stick the center and then the sides, in order to make sure that there is a perfect adherence. This device is pressed on the core by a spring and the roller A grips the rubber band which is flattened and wound up on the drum 18 after the set of rolls 26 have been removed. As a result of the rotary movement of the core in the direction of the arrow, the rubber band is laid on the core; and, after leaving the roller A, the band is seized at its sides by the rollers B, which operate to stick it down. The movement of the core unrolls the band from the drum in order to place it on the core.

The manufacture of the tire is then finished and all that remains to be done is to prepare it for molding.

CLAIMS

1. In a machine for mechanically manufacturing casings for pneumatic tires, characterized by the fact that several gears and clutches impart to an annular core various rotary motions appropriate to the phases of the manufacture and enable the employment of special devises constituting part of the machine, substantially as described and shown in the annexed drawing.

2. In the machine for mechanically manufacturing casings for pneumatic tires, as claimed in claim 1, a set of gears and of spherical rollers for producing a uniform lengthening and convexing of the fabric, thereby facili-

tating the sticking of it to the core, substantially as described.

3. In a machine for mechanically manufacturing casings for pneumatic tires, as claimed in claim 1, a device consisting of one or more sets of rollers carried by a carriage which receives, through a bent shaft, a reciprocating movement perpendicular to the axis of the core in order to stick the fabric on the sides of the core, substantially as described.

4. In a machine for mechanically manufacturing casings for pneumatic tires, as claimed in claim 1, a tool carrier having rollers and arranged to move downward automatically and progressively, dependent on the rotation of the core, in order to progressively efface the puckers of the successive strips of fabric and to apply these strips on the beads, substantially as described and shown in the annexed drawing.

5. In a machine for mechanically manufacturing casings for pneumatic tires, as described in claim 1, a set of two rollers acting under the pressure of a hand lever, for sticking on the beads; a suitable entrance guide being provided in advance of the rollers for ensuring an absolutely exact laying on of the beads, substantially as described and shown in the annexed drawing.

6. In a machine for mechanically manufacturing casings for pneumatic tires, as claimed in claim 1, a device for trimming the fabric strips after they have been set in place, this device consisting of a hand lever fixed on the tool carrier of the machine and having a blade, so that manual pressure on the lever will cause the fabric strips to be cut.

7. In a machine for mechanically manufacturing casings for pneumatic tires, as claimed in claim 1, a set of three spring actuated rollers, which first stick down the center and then the edges of the rubber band which completes the tire.

8. The process of manufacturing casings for pneumatic tires by the use of the machine and its devices claimed in claims 1 to 7, and comprising the following operations:

(*a*) winding the fabric strips on the core, after a preliminary lengthening and convexing; (*b*) sticking the fabric on the sides of the core; (*c*) eliminating the puckers formed; (*d*) laying on the beads; (*e*) trimming the fabric strips; (*f*) sticking on the rubber strip, all these operations being performed mechanically and during the rotation, at different speeds, of the annular core.

Brussels,

September 20, 1906.

Through the application of Mr. A. Matherne.

(s) G. Noel.

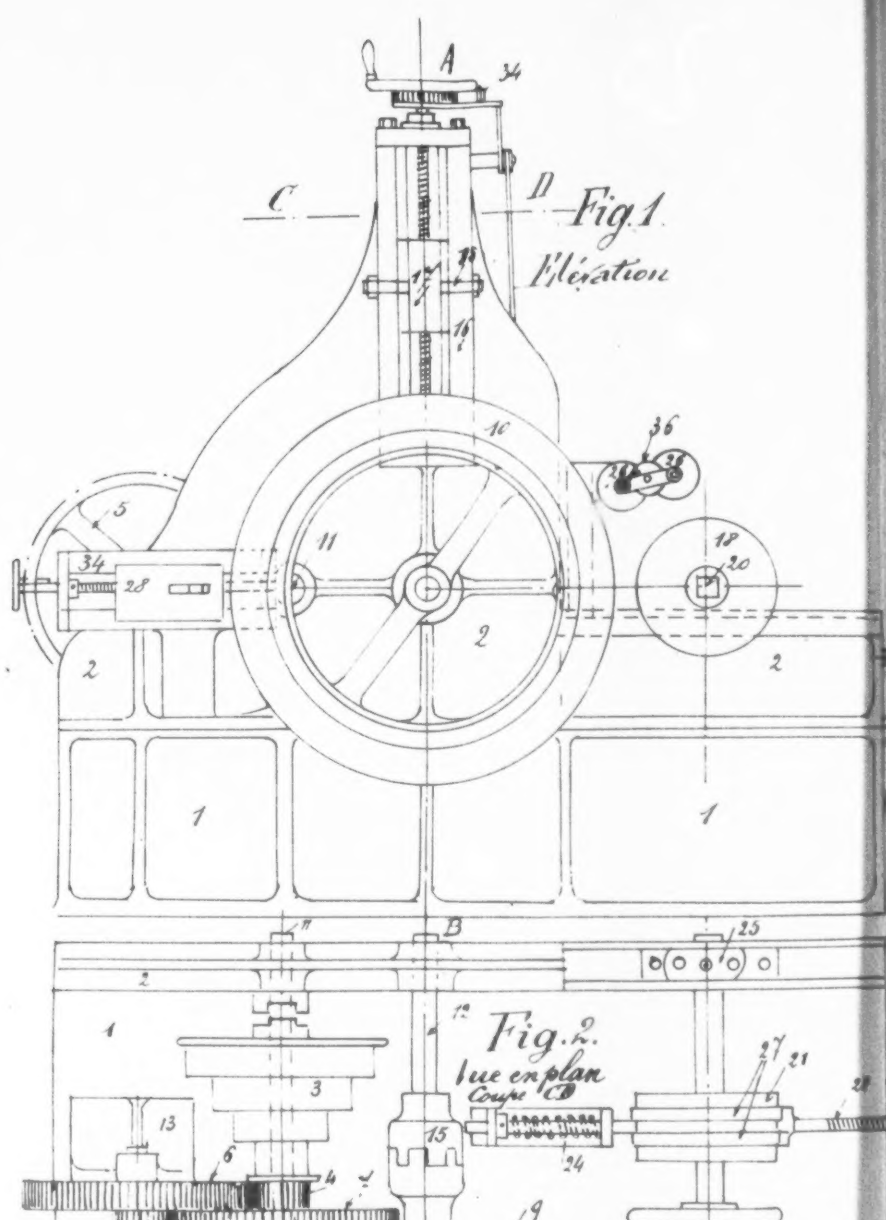
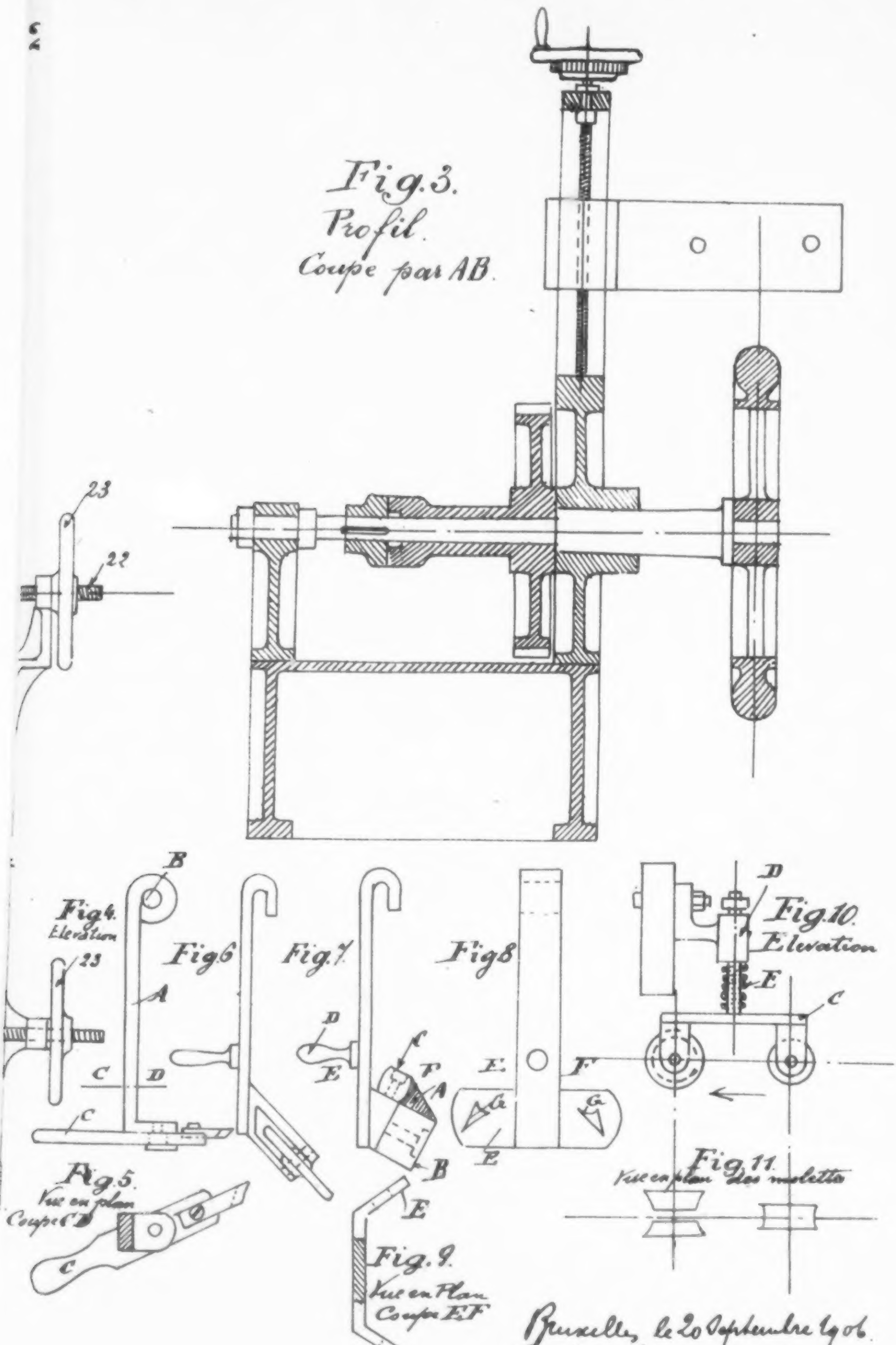


Fig. 1. Élévation

Fig. 2. Vue en plan Coupe CD



Bruxelles, le 20 Septembre 1906.
Par P.on de M.r A. Matherne,
(s.) G. Noël.

[Second Edition.]

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Date of Application, 5th Nov., 1909—Accepted, 28th Apr., 1910

COMPLETE SPECIFICATION.

Machine for Making Open-bellied Pneumatic Tyre-shoes.

I, WILL CHARLES STATE, Corner of College and East Market Streets, Akron, Ohio, United States of America, Mechanical Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

My invention relates to a machine for the manufacture, from flat sheets of rubber-coated canvas of the open-bellied casings or more briefly the open casings of tire-shoes which are used in connection with an inflatable inner rubber tube to constitute the double-tube pneumatic tires now used on automobiles and the like.

My machine comprises a power-driven ring-core in connection with a pair of stock-rollers which have wound thereon strips of sheeted canvas skim-coated with rubber and cut on the bias. By this means I am enabled to supply a round of canvas on the ring-core from the roll and then a second round of canvas on the ring-core from the other roll. By properly arranging the rolls with respect to each other, the superposed layers of canvas on the ring-core will have their threads crossed, as is necessary in building strong tires. The pair of stock-rollers may be mounted one above the other, or side by side on a sliding or rotary table so that the stock can readily be drawn therefrom to the power-driven ring-core in alternation. This combination in an open tire-shoe making machine of a power-driven ring-core with a pair of stock-rolls from which alternate layers of crossed fabric may be supplied to the ring-core is an important feature of my invention.

A layer of canvas having been applied to the ring-core, a radially movable smoothing or tread-forming roll firmly shapes and presses the canvas against the ring-core near its external periphery to form the parts of the tire which lie under its tread portion. Thereupon a pair of spinning-rolls gradually press the canvas in contact with the sides of the ring-core toward its internal periphery to shape the sides of the tire. These spinning-rolls are spring-pressed and their outer periphery or working edge is disc-shaped and rounded so as not to cut the fabric. The spinning-rolls are also radially movable with reference to the ring-core. They have been found peculiarly efficient in shaping the sides of the tire-shoe and form an important feature of my invention. They are sharply differentiated from the hammers or sliding finger devices heretofore proposed for the purpose. So, too, the combination of the tread-forming roll for operating upon the tread portion and the spring-pressed spinning-rolls for shaping the sides of the tire-shoe forms an effective instrumentality for completely shaping the tire and an important feature of my invention.

In order to prevent the several spiral layers of canvas, which are skim-coated or saturated with rubber, from sticking together while on the stock-roller, I place a strip of plain muslin or the like against the rubber-coated canvas and wind this combination upon the stock-roll. It becomes important, then, when the rubber-coated canvas is drawn onto the ring-core from the stock-roll that provision be made for disposing of the muslin which is unwrapped at the same time. To this end I apply as another feature of my invention a take-up roll for the muslin which is driven by frictional contact against the outer surface of the stock-roll.

[*Price 8d.*]

It is important to secure proper tension on the fabric as this is drawn from the stock-roll onto the ring-core. To this end I cause the fabric to pass over a rubber-covered roll to which some form of tension brake is applied. I have found, also, that the fabric in passing under tension from the stock-roll to the ring-core forms longitudinal creases. These I remove by a stretching-roll supplied with a pair of divergent spirals on its surface.

Without unduly extending this preliminary outline of my invention, I may say that an important feature of my machine results from the fact that I apply the canvas to the power-driven ring-core while this is moving quite slowly, say at six revolutions a minute. I have discovered, however, that it is not only possible but highly desirable to let the smoothing- and spinning-rolls operate upon the ring-core while this is moving at a much higher speed, say at two hundred and seven turns a minute. By this means the machine not only does more work in a given time but does better work.

I shall now describe, in detail, the machine which constitutes the best embodiment of my invention now known to me.

In the drawings,—

Figure 1 is a plan of my device;

Figure 2 is a view in side elevation looking from the right of Figure 1 with portions in section to illustrate the internal construction thereof;

Figure 3 is a sectional view of the mechanism for supporting and rotating the core on line X of Figure 4;

Figure 4 is a sectional view of the mechanism shown in Figure 3 on line Y thereof;

Figure 5 is a view in side elevation of the mechanism for communicating motion to the mechanism shown in Figures 3 and 4;

Figure 6 is a view in end elevation of the support and tool carriage on which the devices used for manipulating, shaping and smoothing the fabric while being placed on the core are mounted;

Figure 7 is a view in side elevation of a tension regulating device;

Figure 8 is a view, in central section, of a lock employed in this device;

Figure 9 is a plan of a turret on which the mechanisms for manipulating the tire are mounted, also showing the various tools employed in connection with this type of device on a ring-core shaped for clincher tires;

Figure 10 is a sectional view of a standard and reel on which a supply of rubber-coated fabric is mounted;

Figure 11 is a view partly in elevation and partly in section of a chuck on which the core is mounted while the tire is being formed thereon;

Figures 12, 12^a, 12^b, 12^c are cross-sections of a ring-core for inextensible-edge tires with the fabric in different stages of application;

Figure 13 is a diagram of a ring-core used alternately in connection with a pair of stock-rolls on a sliding support; and

Figure 14 is a diagram of a pair of superposed stock-rolls used alternately in connection with a ring-core.

Referring to the drawings in detail, 1 is the base carrying a cylindrically-formed member 3 upon which loosely turns the rotary head 8 by means of a ball-bearing connection 5. The head 8 is provided with a series of pairs of lugs 13, the space between each pair forming a recess to receive a locking member 14 mounted on the side of the cylinder 3 for arresting at predetermined intervals the movement of the head. Extending upwardly from the head 8, as seen in Figure 1, are two varieties of standards 15, 16. The four standards are L-shaped in cross-section and are positioned with the angles or corners thereof inwardly towards the axis of the cylinder 3. Mounted on these standards 15 and 16 are four complete sets of rolls, and as these sets of rolls are similar, a description of one will be sufficient. Each set of rolls comprises a stock-roll, a take-up roll, an idle roll, a rubber-covered tension-roll and a stretching-roll which will now be described.

Extending laterally from the standard 15 is an integral arm 24, shown best in Figure 10, from the outer end of which projects a stub shaft 25 provided with a spring catch 26 for holding a stock-roller 27 on which the supply of rubber-saturated fabric 28 is wound, the successive layers of which are prevented from sticking together by interposing between them a strip of muslin or cloth 29. By releasing the catch 26, the roller 27 may be removed from its shaft 25 and replaced by another roller on which a fresh supply of fabric and cloth is wound whenever the supply on the original roller becomes exhausted.

Mounted on the shelf 17 (Figures 1 and 2), which extends horizontally across the upper corner or angle of the standards 15, is an upright hanger 18 having a laterally extending arm 19 to the free end of which is pivotally mounted a depending yoke 20 which has mounted on pins in its free ends thereof a roller 23, hereinafter designated as the take-up roller.

Below the arm 24 is an idle roller 30 (see Figure 2) mounted between the standards 15 and 16.

In the front or outer portion of the standards 15, 16 are bearings to receive a shaft on which is mounted a tension roller 36, preferably having its outer face covered with a layer of vulcanized rubber 361, which rubber-coating I have found peculiarly efficient. The tension-roll constitutes a highly important element since it secures the application of the several layers of fabric to the ring-core with a uniform degree of tension. To this end there is mounted on one end of the shaft which bears the tension-roller 36 (Figure 2) a disc 42 (Figures 2 and 7) around which a friction band 43 having one end anchored to a post 44 on one of the standards and having its other end connected to a rod 45 bearing a tension measuring gauge 46 and a turnbuckle 47 at its lower end. The turnbuckle 47 is connected with some fixed support such as the base 8 by means of a second rod 48. If increased tension is desired on the tension-roller 36 the turnbuckle 47 is manipulated so as to cause a contraction of the friction band 43 on the disc 42 to a determined degree, indicated by the gauge 46, so that a predetermined amount of resistance will be offered to the turning or movement of the tension-roller 36.

I have found that as the ring-core draws the fabric under tension from the stock-rolls, the fabric forms troublesome longitudinal creases which must be got rid of. The expedient which I have finally hit upon for this purpose consists of a stretching-roll 41, here shown as mounted in a swinging frame 40. The outer surface of the stretching-roller 41 is provided with two spirally arranged sets of grooves both commencing at the longitudinal central line thereof and diverging spirally therefrom to cause it to laterally stretch and smooth the rubber-saturated fabric which is drawn partly around it in its passage from the tension-roller, the effect of the roller being to remove all longitudinal creases and other wrinkles which will be formed in the fabric during the removal of the stock from the stock-roller on its passage to the ring-core. The arms 40 are permitted to swing on bolts and are held in any determined position by tightening nuts. By passing the fabric over the tension-roll and under the stretching-roll, the fabric is in contact with the surfaces of these rolls for a considerable fraction of the circumference.

It will be understood that the stock-roll, the idle-roll, the tension-roll and the stretching-roll constitute a single set of rolls, there being, in the case shown, four sets or two pairs of sets of rolls in all, one pair of set of rolls cooperating with one ring-core and the other pair of set of rolls cooperating with the other ring-core. Considering the pair of stock-rolls which cooperate with a single ring-core, it is understood that the rubber-coated canvas is applied to the two stock-rolls in such a manner that when they cooperate with the ring-core the threads of the fabric from one roll will be at an angle with the direction of the threads of the fabric from the other roll. This is brought about, in the construction which has just been described, by mounting a pair of sets of stock-rolls upon the rotary head 8. But the same result could be obtained among numerous other

ways by mounting a pair of stock-rolls upon a sliding head, as shown in Figure 13, or by mounting the stock-rolls one above the other, as shown in Figure 14 and placing the stock upon the pairs of stock-rolls so that their threads will come at angles to each other when supplied to the ring-core.

The operation of a set of rolls is as follows: In order that the ring-core may take hold of the fabric, the core is coated with rubber or cement. The rubber-coated canvas is now unwound from the stock-roll and carried downwardly under the idle roll 30, and from thence upwardly around the tension-roll 36, and from thence downwardly under and around the stretching-roll 41, and finally onto the power-driven ring-core to which the end of the canvas is made to adhere. Since the ring-core is power-driven at a low speed, the rubber-coated canvas will be drawn outwardly from under the surface of the stretching-roll as well as over the surface of the tension-roll. In this manner the fabric will be smoothed by the stretching-roll and the proper tension will be applied to it by the tension-roll. When one round of canvas has been applied to the ring-core, the length is cut off by the workman's scissors from the portion remaining on the stock-roll. The cloth which is interposed between the layers of the rubber-coated canvas on the stock-roll passes downwardly around the under face of the stock-roll and from thence upwardly and is then rewound on the take-up roll 23 which, being hung between the arms of the pivoted yoke 20, frictionally rests on the surface of the stock-roll 27, thus receiving motion thereby.

During the operation of withdrawing the strip of rubber-coated canvas from the stock-roll, the lug 14 (Figure 2) will be inserted in the recess between the lugs 13 to prevent the revolution of the head 8.

I have now to describe the source of power for the ring-core. Mounted on the base 1 is a motor 49 having a sprocket wheel 50 driving a sprocket chain 51, passing around a sprocket wheel 52, on a shaft 53, supported by brackets 54. The shaft 53 carries at its ends, sprocket wheels 55 driving sprocket chains 56, passing around the loose members of clutches 57, which with their cooperating tight members 59 are mounted on shafts 58 (Figures 3, 4, 5) and are operated by clutch levers 59^1.

Mounted on suitable ways 60 at each end of the base 1 are housings 61. Each of these housings may be provided on its under surface with suitable grooves so as to render them movable on the ways 60 and is held in a determined position by means of bolts 62, the lower ends of which engage in slots 63 formed in the base 1. The housing 61 is hollow and is provided with an opening through which the shaft 58 enters (Figure 4). Within the housing are a pair of aligned brackets provided with bearings bolted to the walls of the housing and supporting one end of the shaft 58. Extending longitudinally of the housing 61 and supported in bearings suitably secured to inturned flanges 69 formed integral with the body of the housing is a shaft 70 near the longitudinal centre of which is splined a clutch member 71 having its two lateral faces formed to engage corresponding clutch members 72 and 73 mounted loosely on said shaft 70. The clutch member 72 is provided with a hub 74 rigidly secured to a spiral gear 75 adapted to be driven by means of a worm 76 mounted on the shaft 58 just as the corresponding clutch member 73 has a hub 84 secured to a spiral pinion 83 driven by a worm 82 on a shaft 78. The shaft 78 is driven from the shaft 58 by a chain and sprocket connection and the arrangement is such that the spiral gear 83 rotates more slowly than the spiral gear 75.

It will thus be seen that the shafts 58 and 78 are power-driven and rotating when the clutch members 57 and 59 are engaged. With them rotate the clutch-members 72 and 73, which are loose on the shaft 70. By throwing the clutch member 71, which is splined on the shaft 70, into connection with either the clutch members 73 or 72, the shaft 70 is made to revolve slowly or rapidly. The movement of the clutch member 71 is effected by the shifting lever 86.

Mounted on the shaft 70 outside of the housing 61 is a gear 88 (Figure 5) adapted to mesh with a pinion 89 secured to the extended end of a shaft 90.

mounted in the upper part of the housing 6ll and carrying a locking-disc 93. Cooperating therewith is a spring pressed locking-pin 100 held out of engagement with the locking-disc by a cross-pin 97 moving in a slot in the casing 95 (Figure 3). To lock the shaft 90 in a fixed position, the pin 100 is allowed to assume the position shown in Figure 3. To permit the shaft 90 to rotate, the pin 100 is withdrawn from contact with the locking-disc 93 and held in this withdrawn position by the cross-pin 97, which bears against the end of the casing 95, all in a manner readily understood.

I have now to describe the chuck for carrying the ring-core. Mounted on the shaft 90 is a chuck (see Figure 11) comprising a cup-shaped body portion 101 provided with an internally threaded hub 102 to receive the end of the shaft 90. The interior of the member 101 is further provided with a flange 103 provided with openings 104 in radial alignment with similar openings 105 in the outer face of the chuck. Positioned in these openings 104 and 105 are exteriorly threaded shafts 106 carrying between the flange 103 and the outer wall of the chuck, nuts 107 the exterior faces of which are formed with beveled gear teeth. Secured to the outer wall of the chuck by means of screws 108 is an annular flange or ring 109 extending inwardly from the outer wall of the cup-shaped member a short distance. Mounted in the space enclosed by the ring 109 is a disc 110 provided with a central opening 111 and with a plurality of openings 112 disposed in a circle concentric with the opening 111. The outer edge of the disc 110 is provided with a shoulder to receive the ring 109 for positioning and holding the disc in place. The inner face of the disc is provided with gear teeth adapted to intermesh with the teeth on the nuts 107. Mounted in the flange 103 are keys 113 arranged to enter key-ways 114 cut longitudinally of the shafts 106 for locking them against rotation in unison with the nuts 107. The outer ends of the shafts 106 are preferably beveled to form a sharp edge for a purpose to be hereinafter described. This chuck is adapted to temporarily hold the ring-core on which the tire casing is to be built. The ring-core (Figure 2) is provided with an inwardly-extending flange 116 having at intervals V-shaped slots 117 to receive the outer ends of shafts 106.

While I have described the mechanism for driving and supporting the ring-core in detail, so that its exact construction may be understood, it will be seen that in its essence I employ a slow-speed mechanism, in this case represented by the clutch member 73, and a fast-speed mechanism, here represented by the clutch member 72, and a speed-changing mechanism, here represented by the clutch member 71 and its shifting lever 86. But when I use the terms fast-speed mechanism, slow-speed mechanism and speed-changing mechanism in the claims, it is understood I mean any class of mechanism accomplishing these functions and not merely the specific mechanism herein shown. Power is thus transmitted from the shafts on which are mounted sprocket wheels 50 and 52, and shaft 58 (Figure 5) to the shaft 70 (Figure 4), and in turn to the shaft 90 which, by means of a suitable chuck, carries the ring-core. To mount the ring-core on the chuck, the shifting lever 86 is placed in its intermediate position with the clutch member 71 out of contact with either the fast- or slow-speed mechanism. The locking-stem 100 is now permitted to come into engagement with the locking-disc 93 to hold the shaft 90, which carries the chuck, in an immovable position. This permits the ring-core to be readily placed on the chuck. Thereupon the locking-stem 100 is withdrawn from engagement with the locking-disc 93 and the speed-shifting lever 86 is operated to throw the slow-speed mechanism into action. The ring-core is now rotated at a slow speed. At this time a single layer of rubber-coated fabric is drawn onto the ring-core from the stock-roll. The shifting-lever is now quickly actuated to stop rotation of the core. Thereupon a pair of scissors in the hand of the operator separates the strip of rubber-coated canvas, which is around the core, from the canvas wound on the stock-roll. The speed-changing mechanism is now again actuated to bring the fast-speed mechanism into action. Thereupon

the tread-forming and spinning-rolls are brought into play. The supports for these I now proceed to describe.

Slidably mounted on the base 1, substantially below the position occupied by the chuck just described, is a standard 118 comprising a hollow metallic box having outlines approximately concentric with the shaft 90 provided with a depending lug 119 in its lower portion through which extends a screw 120, manipulated by a hand-wheel 121 for shifting the standard 118 towards and away from the ring-core 115, thereby making it possible to position and adjust it with respect to the latter when different sized cores are used. The upper portion of the standard 118 is provided with an outwardly-extending dovetailed portion 122 (Figure 6) on which is slidably mounted a carriage 123 provided with a depending lug, indicated in dotted lines in Figure 2, similar to the lug 119, adapted to receive a screw controlled by a hand-wheel 124 for shifting it toward and away from the core.

In the side of the standard 118 immediately below the carriage 123 is a pivoted arm 125 provided with a pin 126 adapted to enter a hole 127 in the side of the standard 118. Depending from the side of the carriage 123 is a lug 128 provided with a pin 129 threaded to permit its adjustment in the lug 128. When the arm 125 is swung upwardly so that the pin 126 is positioned in the hole 127 the pin 129 will engage the arm 125 and arrest further inward motion of the carriage thereby constituting an adjustable stop for accurately limiting the movement of the carriage with respect to the core. The carriage 123 bears an upwardly-extending centrally-placed pin 130 on which is mounted a revoluble head or turret 131 held from displacement by a nut 132. Reference is here directed to Figure 9. The turret 131 bears a lock 133 (indicated in Figure 1) exactly similar to the lock shown in Figure 8, provided with a vertically-shiftable stem the lower end of which is adapted to enter suitable openings 134 in the upper face of the carriage 123, and lock the turret in determinate positions.

The revolving head or turret 131, which is shown simply as a sample of one type of transversely movable support I may employ, bears what for lack of a more suitable name I call the tread-forming-roll 141, the spinning-rolls 147, the cutters 149 and the bead-attaching rolls 156, which can be alternately brought into play because of the rotary or transverse movement of the head 131 with respect to the ring-core. These instrumentalities may be juxtaposed to the ring-core, one after the other, by rotating the head. Since the supporting head 131 is radially movable with reference to the ring-core by means of the hand-wheel 124, it follows that each of the instrumentalities mounted thereon is radially movable with respect to the ring-core. In the case of the tread-forming-roll 141, this permits the operator to gradually bring the proper amount of pressure to bear on the canvas either which lies under or which actually forms the tire tread to thoroughly smooth it and shape it to the core. In case of the spinning-rolls 147, the radially movable support permits the operator to pass the rolls gradually over the surface of the side of the ring-core from the edge of the tread portion to the tire-edge, so as to gradually bring the canvas which is to form the rubber tire into contact with the sides of the ring-core. In case of the pivoted cutters 149 as well as in the case of the bead-applying roll 156, the radial movability of the support renders it possible to position the parts to the proper place for the work intended with different sized ring-cores.

The tread-forming-roll is mounted in brackets on the radially and transversely movable head 131. Its axis, when in operation, is parallel to the axis of the ring-core and its curvilinear shape in longitudinal section is made to correspond to the shape of the outer or tread portion of the ring-core. It will thus be clear that after the operator has drawn a layer of rubber-coated canvas onto the ring-core, he can, by pressing the tread-forming-roll 141 against the fabric, smooth and shape the fabric on the core and get it free of captured air bubbles

or wrinkles over its outer face. This action will be all the more efficient by reason of revolving the ring-core at high speed.

The spinning-rolls 147 are preferably mounted on ball-bearings or similar anti-friction mechanism for they revolve at high speed and exert considerable pressure on the fabric. They are laterally movable, that is to say they are movable toward and away from the plane of the ring-core and this movability I effect, in the case shown, by pivoting them at 146 on arms 144 mounted on pivots 143 on the head 131. A pair of grips or hand holds 142 on the arms 144 enables the operator to force the rolls 147 apart both when they are first applied to the ring-core and when they are withdrawn therefrom, in the backward motion, after their work is finished. The spinning-rolls are also spring-pressed toward the plane of the ring-core by springs 145, here shown, diagrammatically, as leaf springs although, in practice, strong spiral springs will be used. These springs exert the pressure against the fabric for forming it against the sides of the core which would be exerted by the arm of the workman in case of a hand-tool. In consequence the work of these spring-pressed spinning-rolls is far more even and more rapid than in the case of a hand operated roll. And it is of course understood that there may be substituted for the springs the more cumbersome device of a weight constantly tending to force the spinning-rolls, with considerable pressure, toward the ring-core. While I have shown these spinning-rolls as disc-shaped throughout, it will naturally be understood that the disc-like or narrow character of the rolls is only essential at the periphery which is rounded and not sharp so as not to cut the fabric. By having the outer or working edge of the spinning-roll of a narrow or disc-shape or bead form, it follows that this working edge can effectually contact with the fabric at all portions along the sides of the ring-core. This would be impossible with a roller of the type shown at 141. On the other hand, the spinning-rolls are not so well adapted as the rolls 141 to shape the tread portion of the tire. It will be noted finally that I mount the spinning-rolls with their plane not at a right angle to but to recede at an acute angle from the plane of the ring-core. The fact is when the ring-core is rotating at high speed, the centrifugal force tends to throw the fabric out at a right angle from the core-plane and unless the roller recedes in the manner shown, the fabric will become entangled with it. Besides the spinning-rolls, when mounted in this way, are found to have a better forming action on the fabric.

The action of the pivoted cutters 149 will be understood without much description. They are brought into position by turning the head 131 and forced together at the proper time to trim the edges of the fabric which has been applied to the ring-core.

The bead-applying rolls 156, 158 are mounted on the arms 155 which swing on the arms 154. The ordinary bead, such as is used in forming a clincher tire, being put into place on one or more layers of fabric which have already been applied to the ring-core, the rolls 156, 158 are swung into place and press the bead firmly into position as the ring-core rotates.

I have shown in Figure 9 the type of ring-core which will be used for clincher tires. But clearly, my machine can also be used to make tire-shoes of the inextensible-edge type. To this end I use a collapsible ring-core, the shape of which in cross-section is shown in Figures 12, 12^a, 12^b and 12^c. The fabric in the several stages of application is also shown in these several figures. The ring-core has two lateral grooves which furnish lodgment for the heavy inextensible edge which is employed in this class of tires. It will be understood that one or more layers of fabric are applied to the ring-core, that the inextensible edges are then placed into the lateral grooves by hand and that the outer layers or plies of fabric are finally applied over the inextensible edge. In this case the pivoted cutter 149 may be replaced by a knife in the hands of the workman, since the edge of the lateral groove will act as a guide and that

the bead-applying rolls 156, 158 are dispensed with. The tread-forming-rolls 141 and the spinning-rolls 147 are alone used.

Before describing the operation of the device, attention is directed to the fact that the machine is so constructed that there are two cores on which separate workmen can simultaneously work and place fabric, these being placed diametrically opposite to each other, as shown in Figure 1, and each core is provided with its appropriate mechanism all driven from the same source of power.

The operation of my invention will now be reasonably clear. As I have before explained, a ring-core supplied with some adhesive material on its exterior portion is placed upon the chuck while the speed-shifting lever is in position to hold the speed-mechanism out of action. Thereupon, by properly rotating and locking the rotary support for the stock-rollers, a given stock-roll is brought opposite to the ring-core and the end of the fabric thereon is pasted against the ring-core. The slow-speed mechanism being now brought into action, the ring-core slowly rotates, making a single turn in about ten seconds, drawing the rubber-coated fabric from off the stock-roll and around the tension and stretching-rolls. It results that one round of fabric is now applied under uniform tension to the ring-core. Thereupon the speed gear is put out of action, the ring-core stops moving, and the operator cuts the rubber-coated fabric across to separate the round of fabric which is on the ring-core from the fabric which yet remains on the stock-roll.

The fast-speed mechanism is now brought into play. The tread-forming-roll 141 is then brought into action to shape and smooth the tread-portion of the fabric against the outer periphery of the ring-core. The proper pressure is applied to the tread-forming-roll 141 by the devices which make it radially movable, that is by the hand-wheel 124 which radially moves the carriage 131. The parts of the tire which will ultimately lie under the tread having been shaped and the fast-speed gears still being kept in action, the carriage 131 is rotated to juxtapose the spring pressed spinning-roll 147 to the ring-core. The operator forces these rolls apart against the action of the springs. At first the spinning-rolls are positioned to act upon the edges of the tread portion of the tire-shoe. But they are gradually moved radially by the operator by operating the hand-wheel 124 so that they pass over the side portions of the tire-shoe as illustrated in Figures 12^b, 12^c and Figure 9. Thus the entire tire-shoe is gradually shaped to the ring-core. The operator now forces the spinning-rolls apart and operates the wheel 124 in the reverse direction to withdraw them from reach of the ring-core but without touching the fabric in this reverse motion.

A single layer of canvas having been applied to and smoothed and shaped upon the ring-core, it will be obvious that the operator will bring the slow-speed mechanism into action, that he will now take his rubber-coated fabric from a second stock-roll and will apply this upon the layer of fabric already on the ring-core in precisely the same way as the first layer of fabric was applied to the ring-core itself. But, by the provision of the two stock-rolls having the rubber-coated canvas thereon constituted of strips cut on the bias, it will be plain that it will be easy to arrange matters so as to have the threads of the canvas layer first applied at an angle to the threads of the canvas layer next applied. This is necessary to make the best type of tire. Two or more layers of canvas having been applied, the cutter may be brought into action to trim the edges of the tire. Thereupon the bead is put in place and the bead-applying rolls are brought into action. Finally, several more layers of fabric with their threads crossed are applied to the ring-core, precisely as in the case of the layers originally applied.

I may say in conclusion that whereas an operator can make four or five tires a day by hand, he can make from forty to sixty a day by my machine and make them better than they can be made by hand.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In a machine for making open-bellied pneumatic tire-shoes, the power-driven ring-core and the pair of stock-rolls from which, in alternation, successive layers of fabric, with their threads crossed, are supplied to the core.

2. In a machine for the same purpose, the power-driven ring-core and the radially-movable, spinning-rollers laterally spring-pressed against and rotated by the core, having a disc-like periphery which shapes the fabric to the sides of the core in its radial movement.

3. In a machine for the same purpose, the power-driven ring-core, the radially pressable tread-forming roll for shaping the outer portion of the tire, and the radially movable spinning-rolls laterally spring-pressed against and rotated by the core for shaping the sides of the tire.

4. In a machine for the same purpose, the slow-speed mechanism for driving the ring-core while the fabric is being supplied thereto from a stock-roll and the fast-speed mechanism for actuating the ring-core during the action of the radially moving, laterally spring-pressed spinning-rolls.

5. In a machine for the same purpose, the power-driven ring-core and stock-rolls, and the stretching-roll provided with divergent spirally arranged sets of grooves for taking the longitudinal creases out of the fabric which are formed therein in its passage, under tension, from the stock-roll to the ring-core.

6. In a machine for the same purpose, the stock-roll for carrying a spiral winding of rubber-coated fabric and muslin, the yieldingly mounted take-up roll, frictionally engaging the material of the stock-roll for receiving the muslin and the power-driven ring-core for receiving the rubber-coated fabric.

7. In a machine for the same purpose, the stock-roll, the tension-roll covered with a layer of vulcanized rubber and the power-driven ring-core.

Dated this 2nd day of November, 1909.

For the Applicant,

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Norfolk House, Norfolk Street, London, W.C.,
Chartered Patent Agent.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.
[Wt. 15—50/3/1914.]

(2nd Edition)

Fig. 1.

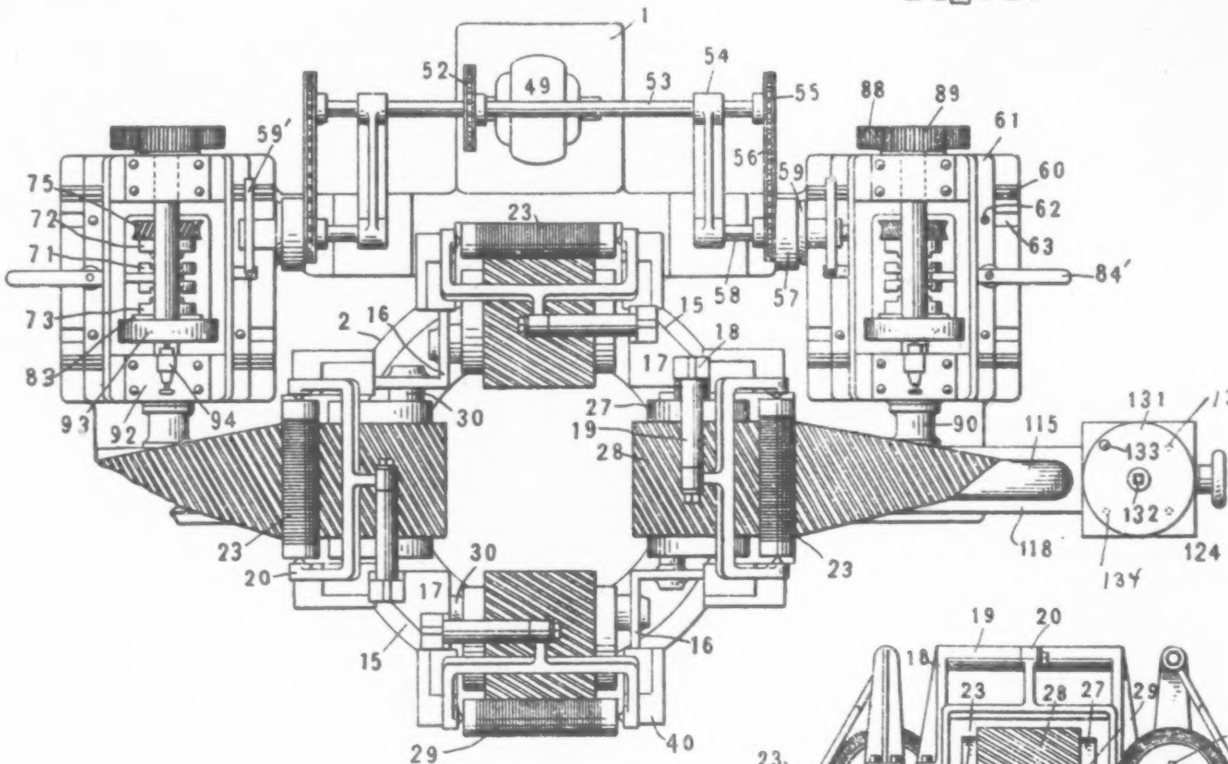


Fig. 2.

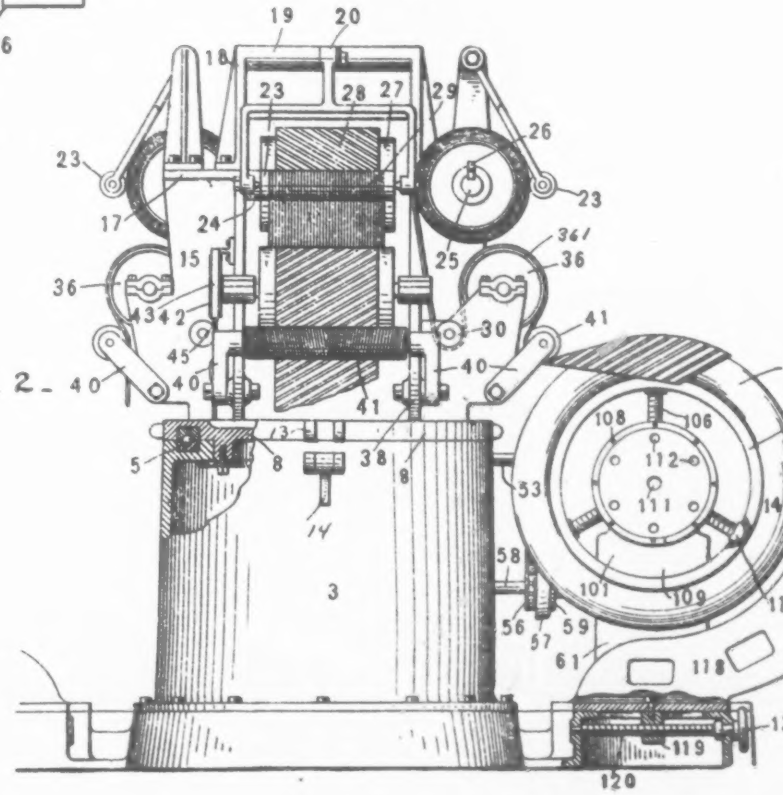
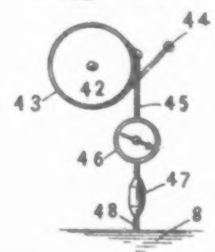


Fig. 7.



[This Drawing is a reproduction of the Original on a reduced scale]

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Fig_3

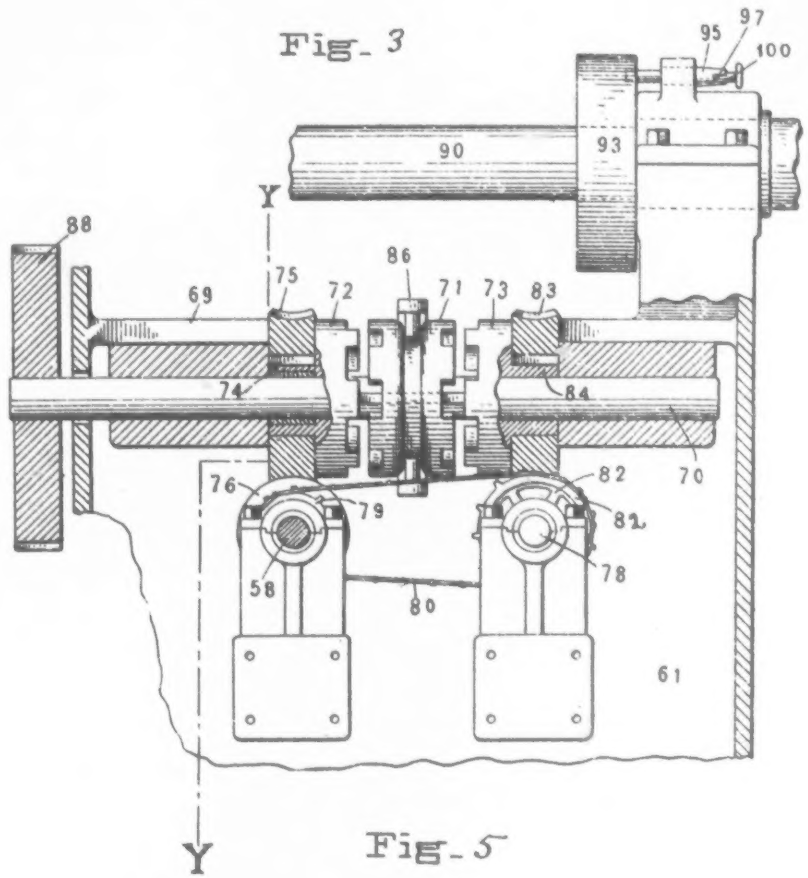


Fig_4

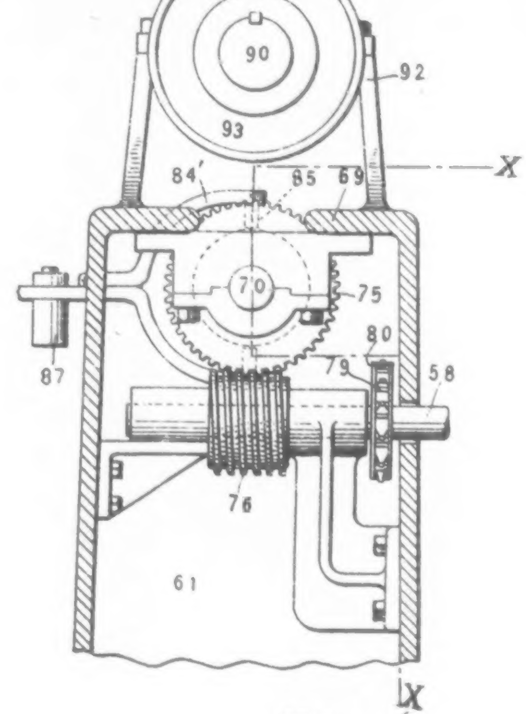


Fig_5

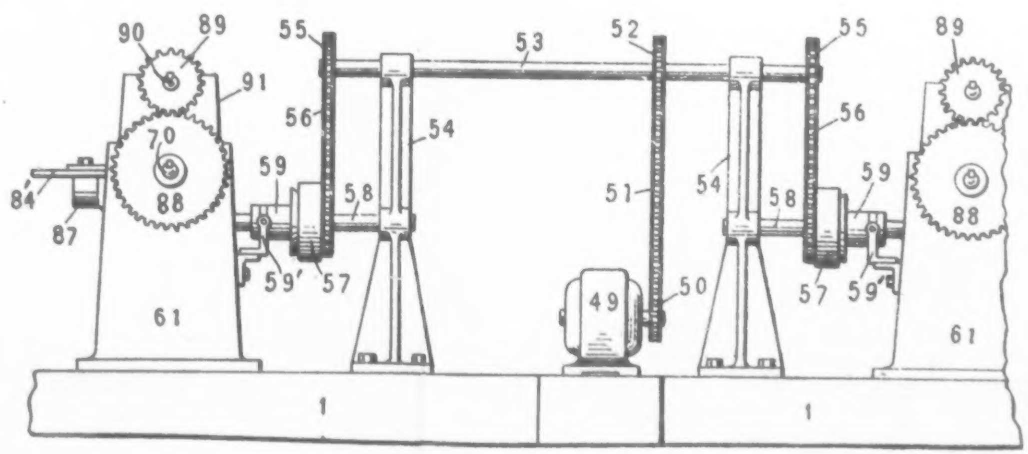
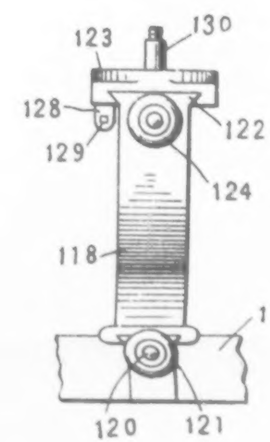


Fig_6



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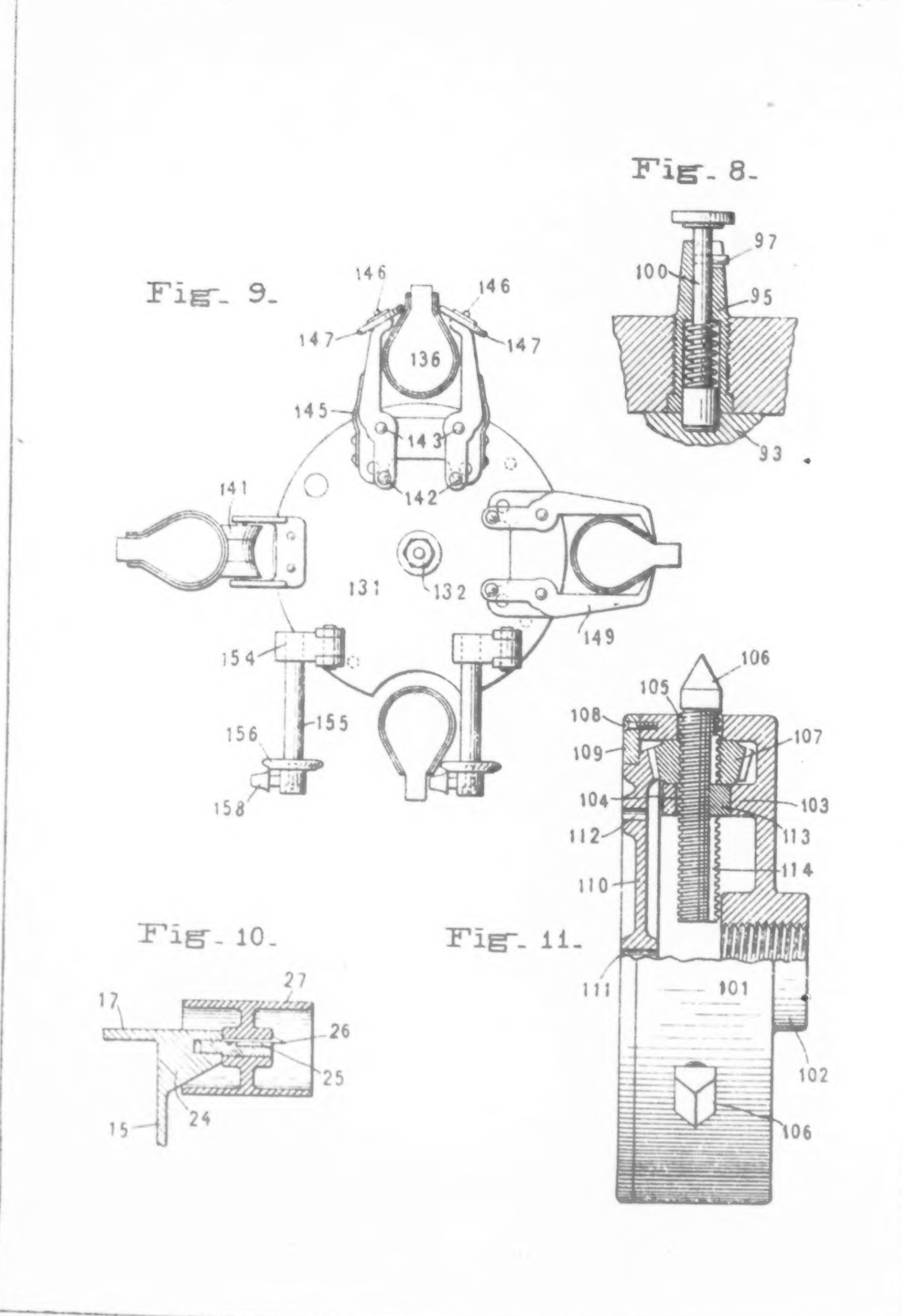
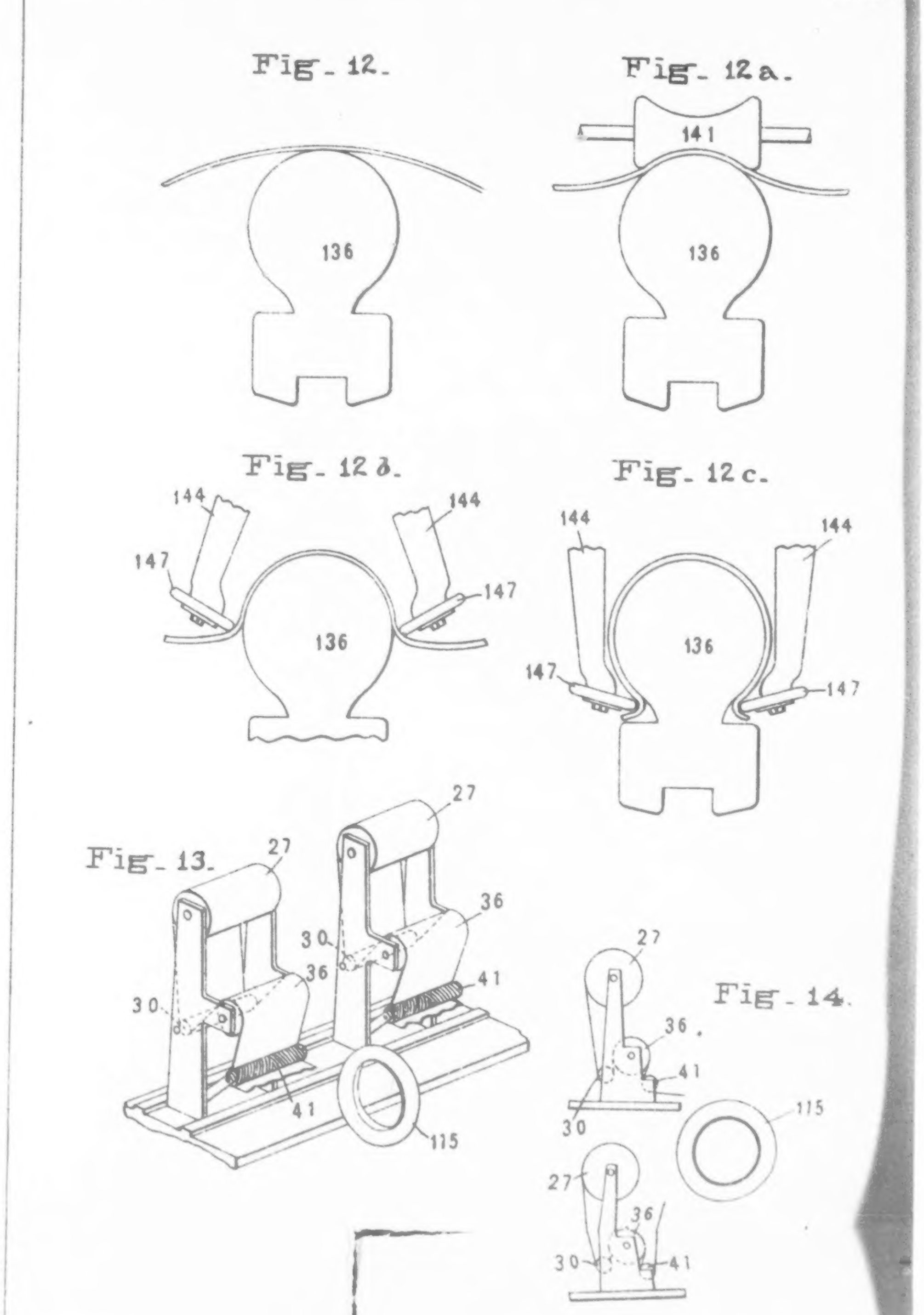
SHEET 3



(4 SHEETS)

SHEET 4



Defendant's Exhibit J—Vincent Patent.

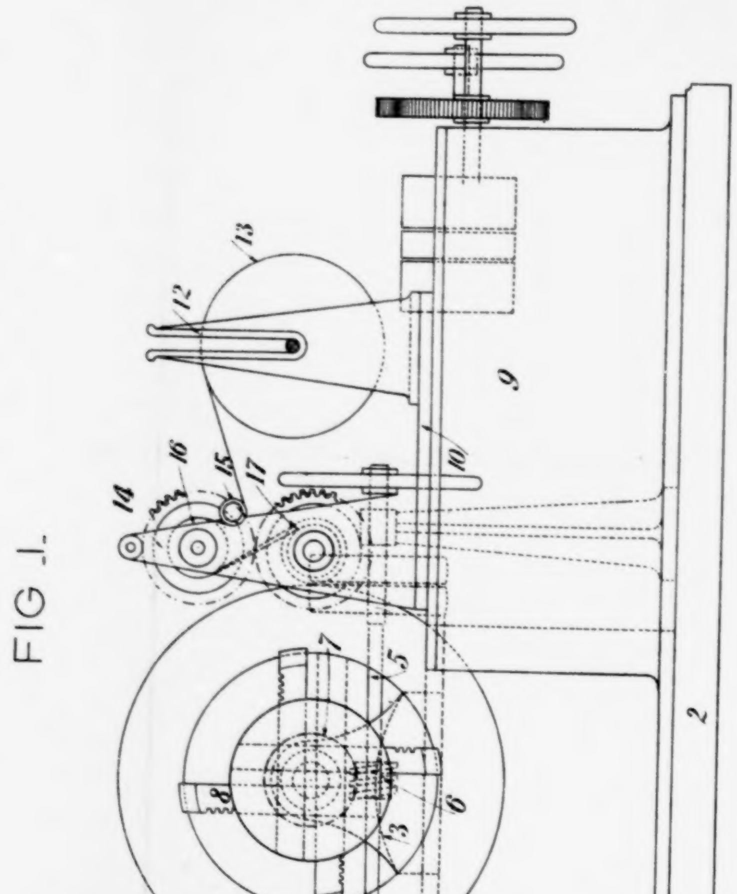
No. 794,473. PATENTED JULY 11, 1905

A. E. VINCENT.

MACHINE FOR MANUFACTURING PNEUMATIC WHEEL TIRES.

APPLICATION FILED APR. 7, 1905.

4 SHEETS—SHEET 1



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No. 794,473. PATENTED JULY 11, 1905.

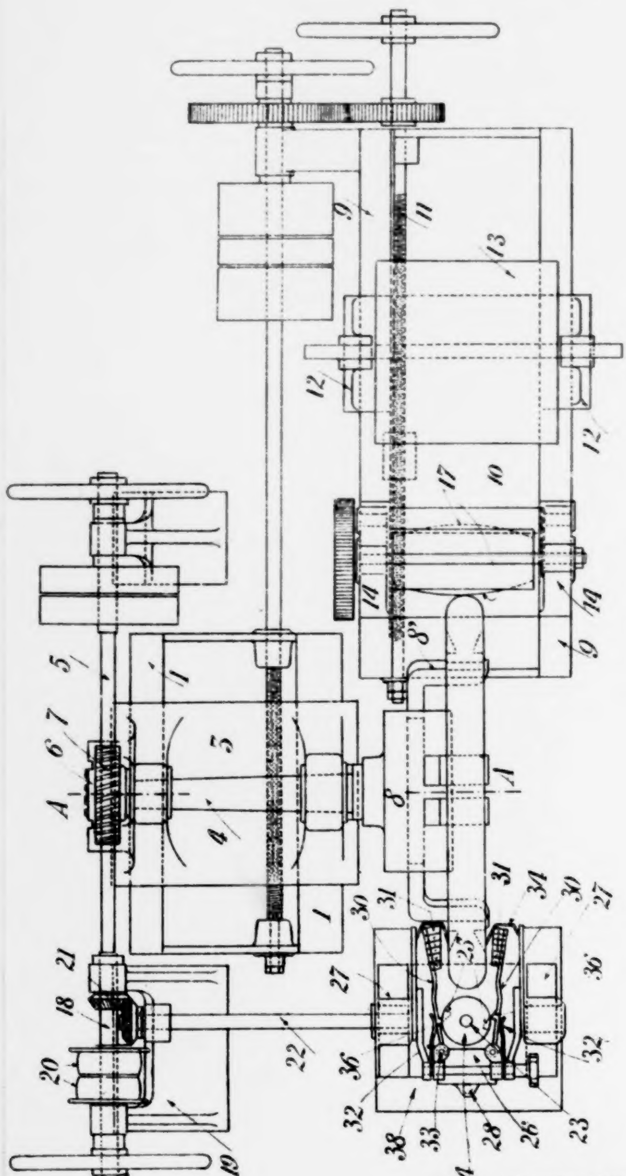
A. E. VINCENT.

MACHINE FOR MANUFACTURING PNEUMATIC WHEEL TIRES.

APPLICATION FILED APR. 7, 1905.

4 SHEETS—SHEET 2.

FIG. 2.



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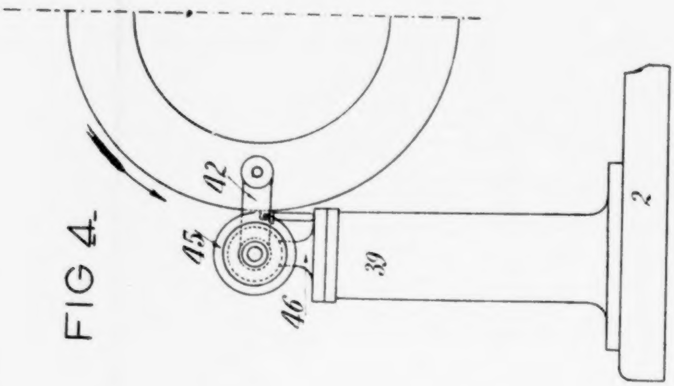

FIG 4.

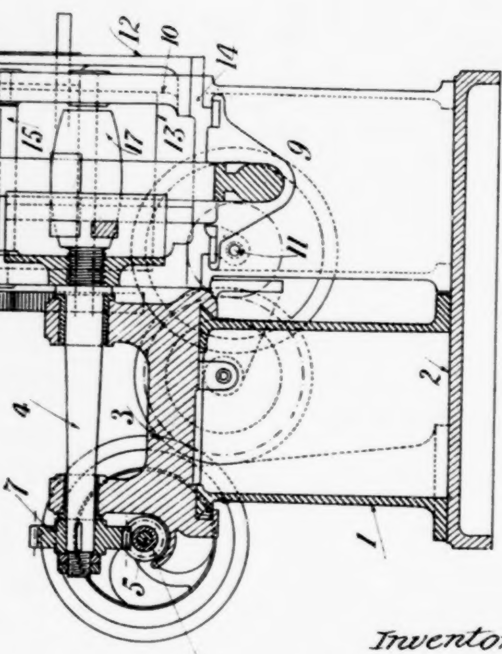

FIG 3.

Witnesses

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252

No. 794,473.

PATENTED JULY 11, 1905.

A. E. VINCENT.

MACHINE FOR MANUFACTURING PNEUMATIC WHEEL TIRES.

APPLICATION FILED APR. 7, 1905.

4 SHEETS—SHEET 4.

FIG. 5.

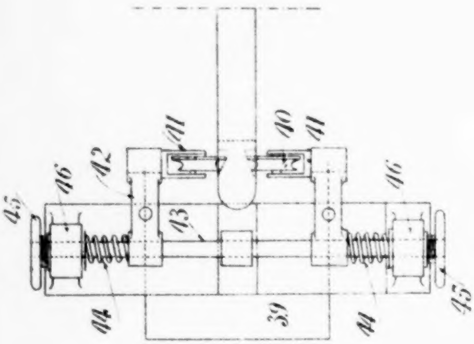
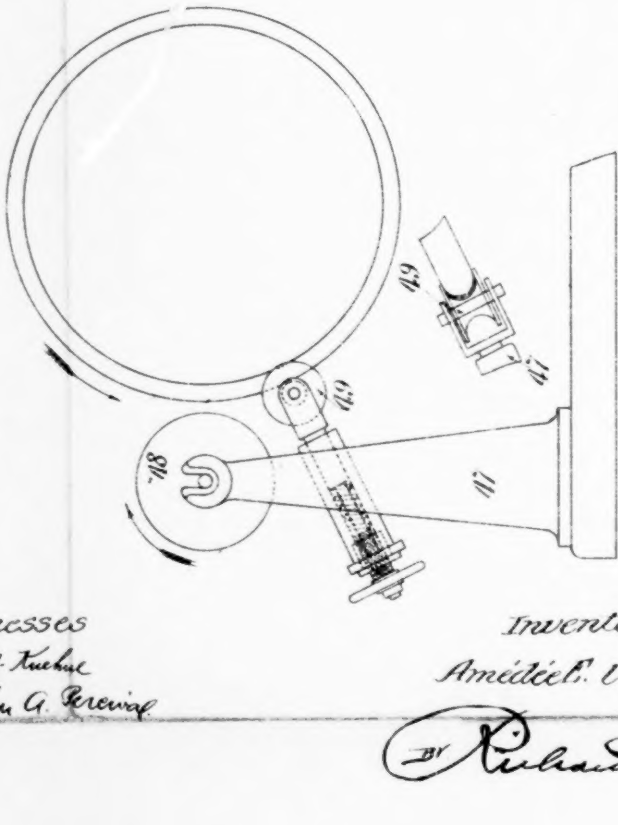


FIG. 6.



Witnesses
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Attorneys.

No. 794,473. Patented July 11, 1905.

UNITED STATES PATENT OFFICE.

AMÉDEE ETIENNE VINCENT, OF NOISY-LE-SEC, FRANCE.

MACHINE FOR MANUFACTURING PNEUMATIC WHEEL-TIRES.

SPECIFICATION forming part of Letters Patent No. 794,473, dated July 11, 1905.

Application filed April 7, 1905. Serial No. 254,412.

To all whom it may concern:

Be it known that I, AMÉDÉE ETIENNE VINCENT, civil engineer, a citizen of France, residing at 25 Boulevard Gambetta, Noisy-le-Sec, Seine, France, have invented new and useful Improvements in Machines for Manufacturing Pneumatic Wheel-Tires, of which the following is a specification.

As is known, a pneumatic tire is made up of several layers of canvas cut in strips on a bias at forty-five degrees and of suitable breadth, two beads or flanges inserted at the base of the canvas, and an exterior layer of rubber for resisting friction.

This invention has for its object a machine for the mechanical production of these tires, enabling, first, to shape and stretch the canvas layers exactly to the same amount whatever be their number, so as to permit the different elements of the tire to work equally. By means of this machine canvas layers are mechanically applied and superposed in suitable number on a metallic matrix or former, and likewise the clenching beads or flanges of the tire and the exterior coating of rubber are mechanically set in place.

In the annexed drawings, Figure 1 is an elevation of the improved machine arranged to apply the canvas on the former. Fig. 2 is a plan view projected from Fig. 1. Fig. 3 is a transverse section along the line A A of Fig. 2. Figs. 4 and 5 show in elevation and in plan the arrangement serving to fix the beads on the tire. Fig. 6 shows the arrangement for applying and securing the tread.

The machine is constructed generally as follows:

A slide frame 1 is fixed on a sole-plate 2. The frame 1 carries a bracket 3, receiving a shaft 4, whose rotary movement is effected from a shaft 5, having a worm 6, operating a worm-wheel 7, keyed on the shaft 4. The other extremity of the shaft 4 is threaded and receives a plate 8 with four extensible arms 8'. On these arms there is placed the metal matrix or former intended to receive the canvas. A second frame 9 is mounted on the sole-plate 2, so that its axis will be in the same plane as the axis of the said matrix or former. On this frame 9 slides a carriage 10, whose movement is effected by a screw 11 engaging a nut fixed to the carriage. On this carriage 10 are fixed two supports 12, which receive a bobbin or reel 13, on which is wound the canvas for making up the tire. The carriage 10 carries also two other supports 14, between which are rotatably carried three rollers 15, 16, and 17. The roller 15 serves merely as a guide for the canvas. The rollers 16 and 17 are driven from each other by two toothed wheels of suitable diameter. The roller 16 is cylindrical. The roller 17 is bulbed in such a manner that the canvas which it receives from the roller 16 is at the middle developed to equal the summit or apex of the former or matrix, while the edges are developed corresponding to the edges of the former or matrix. The shape thus taken by the canvas permits of applying it to the former, covering the same perfectly. The canvas travels along the path indicated by the arrows, then is drawn on the former, which has previously received a coating of rubber solution to permit of the adhesion of the canvas and to insure its being turned with the former, which rotates with the plate 8.

The application of the first layer of the canvas on the former, then of the second on the first, and so on, is insured as follows: A shaft 18, carried by a support 19, fixed on the sole-plate, receives its movement from a system of fast and loose pulleys 20. Bevels 21 transmit motion to a shaft 22, which at its other extremity, also through bevels, drives a vertical shaft 23. On this shaft 23 are mounted a certain number of cams 24, each having two notches 25 opposite each other. The shaft 23 is mounted on a block 26, provided with two trunnions, permitting the same to rock between two supports 27 and to swing back to disengage the former. The block 26 carries at each side a series of levers 30 of unequal length, so that each of the hammers with which each lever is provided at its extremity projects a little beyond the preceding hammer. The whole of the hammers on each side constitutes a step system, as shown in Fig. 1, and all the hammers thus strike upon the face of the former. The levers are each provided with a catch or tappet 36 and are

pressed by springs 32. Each group of levers is mounted on the same shaft 33 at one side. When the shaft 23, on which are fixed the cams 24, makes a movement of rotation, the levers 30 remain superposed in the position indicated in Fig. 2 until the notches of the uppermost cam come opposite the tappets fixed on the two upper symmetrical levers. At this moment these two levers, always pressed by their springs, strike simultaneously upon the canvas on the former, then are immediately afterward raised by the cam, whose rotary movement continues. The second cam keyed beneath the first on the same shaft presents in turn its notches to the second pair of levers the hammers of which strike the canvas as did the first, and so on until the last set of levers, and this while the former, itself rotated in the direction of the arrow, presents successively all its surface to the blows of the small hammers, which first apply the first layer of canvas on the former and insure the perfect adhesion of each new layer of canvas on the preceding layer.

The mode of actuating the small hammers may differ from that above described; but the invention comprises the application to the manufacture of pneumatic tires of the system of small hammers or mechanical strikers striking in turn on the gummed and superposed sheets constituting the tire.

As it is necessary in course of manufacture to control the placing of the beads so as not to glue together all the canvas up to the lower edge, two movable pieces 34 are adapted, as shown in plan, to the hammer system and serve to separate the parts not requiring to be glued together.

For setting the beads or flanges, Figs. 4 and 5, there is employed a tool mounted on a bracket 39, which takes the place of the support 38 on the sole-plate 2 of the machine. The bead is engaged by the operator between the former and the profiled roller 40. This is placed in a chape 41, the tail of which is engaged in a boss 42, sliding longitudinally of the axis 43. The spring 44 presses the boss-support 42, and consequently presses the profiled roller 40, on the bead, and so insuring that the latter will adhere to the canvas of the tire. The tension of the spring 44 is regulated by means of hand-wheel 45, the screw-threaded nave of which moves in a nut fixed to the supporting-bracket 46.

The former, rotated in the direction of the arrow by the action of the spring 44, carries round in its rotation the profiled roller 40 and also the bead itself, which thus is wound and adheres to the tire at the exact position it ought to occupy. Additional rollers suitably profiled insure in the same manner the final adhesion of the upper layers of canvas on the bead thus fixed. There only remains then to effect a single operation, the simplest of all, the mounting of the exterior layer of rubber. This is done by replacing the bracket 39, carrying the bead-rollers, by a bracket 47, Fig. 6, arranged to receive a distributing-drum 48, on which has been rolled the rubber band previously calendered and constituting the rolling face of the tire. The adhesion of the gummed canvas body on the former is insured by a forming-roller 49, the chape of which is carried by the bracket 47. The pressure of said roller 49 on the former is obtained by an arrangement similar to that of the bead-rollers or any other suitable mechanical arrangement for this purpose. The rubber band being mounted on the former between the latter and the roller 49, the former is turned and rotating the band therewith causes to turn the roller 49 and the drum 48. The preparation of the tire is then complete. All the operations have been mechanically effected and the tire is ready for vulcanization.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A machine for the production of pneumatic tires comprising in combination a circular metallic former coated with rubber solution, a rotary plate 8, extensible arms 8 mounted on said plate and adapted to receive the circular metallic former, a bobbin 13 which furnishes the gummed canvas, rollers 15 and 16 over which pass the canvas, a bulbed roller 17 applied against the former and over which passes the canvas before it is applied on said former, small articulated hammers or mechanical strikers 30, 31 of different length and disposed in series on each side of the former, rotary cams 24 adapted to actuate said strikers, and springs 32 adapted to press the strikers against the former, substantially as and for the purpose set forth.

2. A machine for the production of pneumatic tires comprising in combination a circular metallic former coated with rubber solution, a rotary plate 8, extensible arms 8′ mounted on said plate and adapted to receive the circular metallic former, a bobbin 13 which furnishes the gummed canvas, rollers 15 and 16 over which pass the canvas, a bulbed roller 17 applied against the former and over which passes the canvas before it is applied on said former, small articulated hammers or mechanical strikers 30, 31 of different length and disposed in series on each side of the former, rotary cams 24 adapted to actuate said strikers, springs 32 adapted to press the strikers against the former, two profiled rollers 40 adapted to secure the beads or flanges to the tire, sliding supports 42 carrying said rollers, springs 44 acting on said supports and causing the rollers to be pressed against the cheeks of the former, substantially as and for the purpose set forth.

3. A machine for the production of pneumatic tires comprising in combination a circular metallic former coated with rubber so-

lution, a rotary plate 8, extensible arms 8' mounted on said plate and adapted to receive the gummed canvas, rollers 15 and 16 over which pass the canvas, a bulbed roller 17 applied against the former and over which passes the canvas before it is applied on said, former, small articulated hammers or mechanical strikers 30, 31 of different length and disposed in series on each side of the former, rotary cams 24 adapted to actuate said strikers, springs 32 adapted to press the strikers against the former, a drum 48 for distributing the external layer of rubber, a roller 49 adapted to apply said layer of rubber against the body of the gummed canvas mounted on the former, and a spring adapted to press said roller against the former, substantially as and for the purpose set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

AMÉDÉE ETIENNE VINCENT.

Witnesses:
ANTOINE LAVOIX,
ARMAND BLOCH.

Defendant's Exhibit K—Seiberling & Stevens Patent.

No. 762,561. PATENTED JUNE 14, 1904.

F. A. SEIBERLING & W. C. STEVENS.

MACHINE FOR MAKING OUTER CASINGS FOR DOUBLE TUBE TIRES.

APPLICATION FILED NOV. 28, 1903.

NO MODEL. 5 SHEETS—SHEET 1.

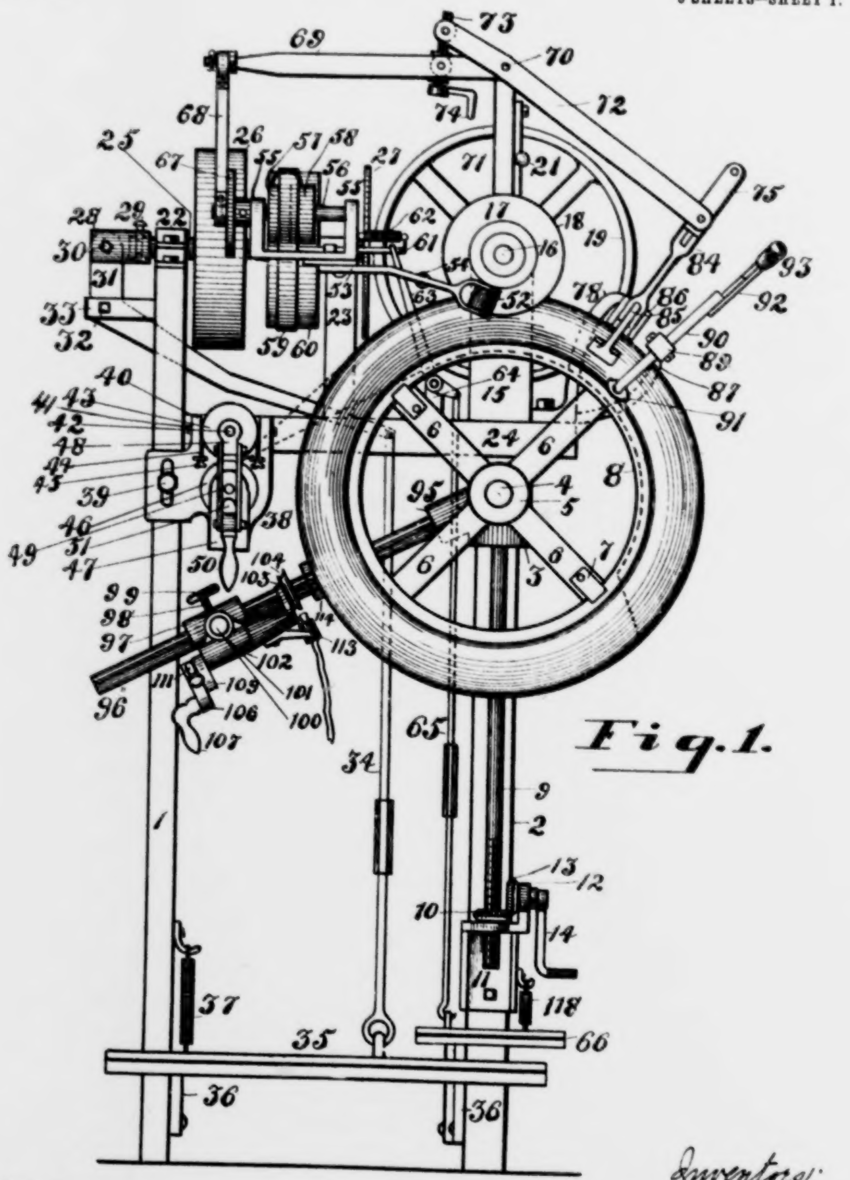

Fig. 1.

Witnesses:

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A. A. Klaig

Inventors:

F. A. Seiberling and

Wm. C. Stevens,

By C. E. Humphrey, Atty.

No. 762,561. PATENTED JUNE 14, 1904.

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MACHINE FOR MAKING OUTER CASINGS FOR DOUBLE TUBE TIRES.

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NO MODEL. 5 SHEETS—SHEET 2.

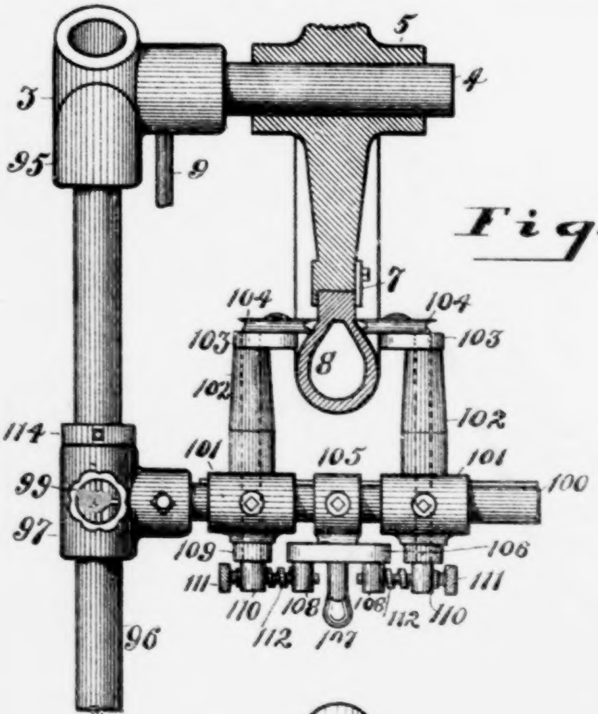

Fig. 2.

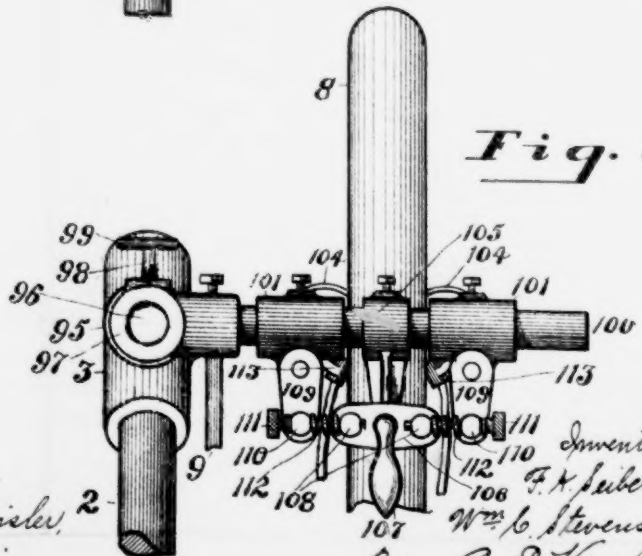

Fig. 3.

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Wm C. Stevens.
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Atty.

No. 762,561. PATENTED JUNE 14, 1904.

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NO MODEL. 5 SHEETS—SHEET 3.

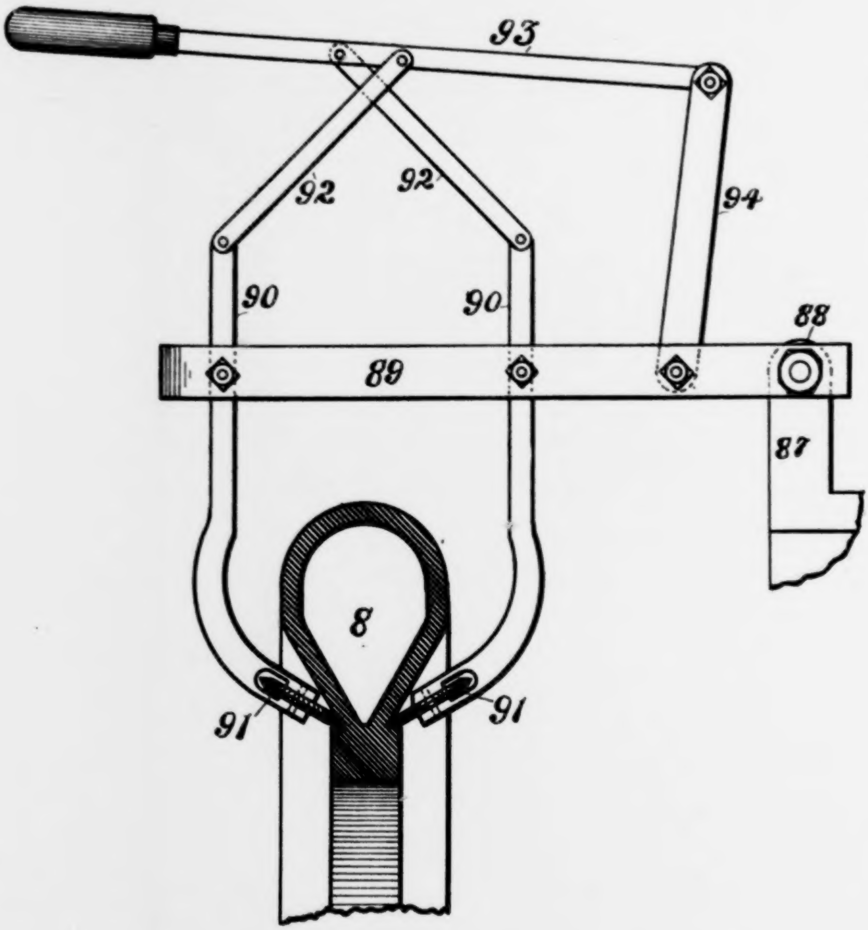

Fig. 4

WITNESSES:
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C A Kling

INVENTORS:
F. A. Seiberling and
Wm. C. Stevens,
BY
C. E. Humphrey
ATTORNEY

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No. 762,561.

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APPLICATION FILED NOV. 28, 1903.

NO MODEL.

5 SHEETS—SHEET 4.

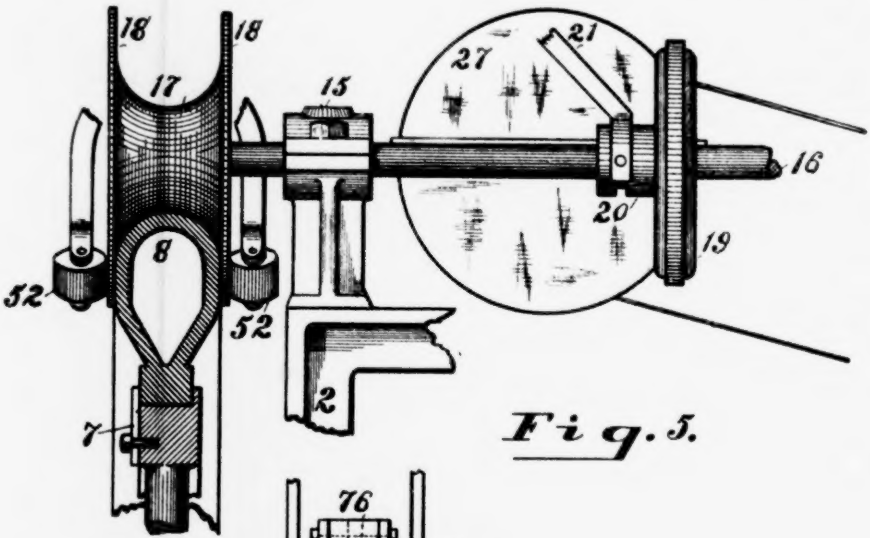


Fig. 5.

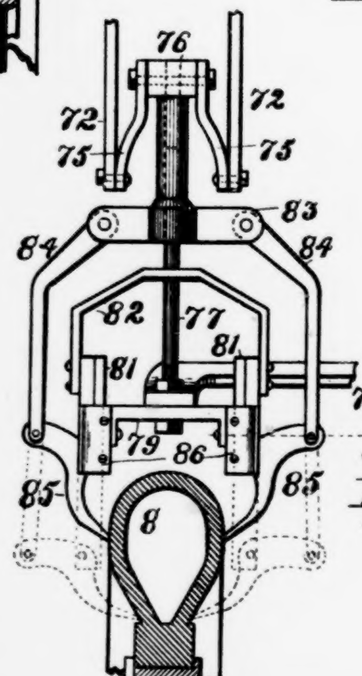


Fig. 6.

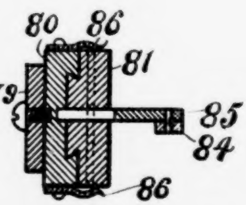


Fig. 7.

WITNESSES:

Maude Zwisler
a. Heling

INVENTORS: F. A. Seiberling and Wm. C. Stevens

BY C. E. Humphrey

ATTORNEY

No. 762,561. PATENTED JUNE 14, 1904.

F. A. SEIBERLING & W. C. STEVENS.

MACHINE FOR MAKING OUTER CASINGS FOR DOUBLE TUBE TIRES.

APPLICATION FILED NOV. 28, 1903.

NO MODEL.

5 SHEETS—SHEET 5

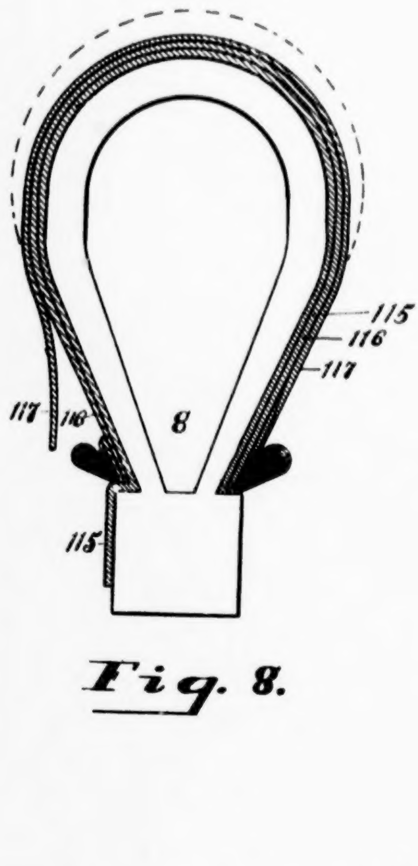


Fig. 8.

Witnesses:
Maude Amisler.
A. E. King

Inventors:
F. A. Seiberling and
Wm. C. Stevens,
By C. E. Humphrey
Atty.

No. 762,561. Patented June 14, 1904.

UNITED STATES PATENT OFFICE.

FRANK A. SEIBERLING AND WILLIAM C. STEVENS, OF AKRON, OHIO.

MACHINE FOR MAKING OUTER CASINGS FOR DOUBLE-TUBE TIRES.

SPECIFICATION forming part of Letters Patent No. 762,561, dated June 14, 1904.

Application filed November 28, 1903. Serial No. 182,987. (No model.)

To all whom it may concern:

Be it known that we, FRANK A. SEIBERLING and WILLIAM C. STEVENS, citizens of the United States, residing at Akron, in the county of Summit and State of Ohio, have invented a certain new and useful Improvement in Machines for Making Outer Casings for Double-Tube Tires, of which the following is a complete specification.

This invention relates to machines for producing the outer tubes or shells of endless pneumatic tires, and is especially adapted to manufacturing comparatively heavy shells, such as are used for automobiles and heavy work.

The objects of this invention are to produce a machine by which the outer shells of heavy double-tube pneumatic tires may be rapidly and efficiently manufactured and to provide this machine with simultaneous coacting mechanism by which the successive layers of fabric of which the outer shell is composed may be laid and placed one upon another with great speed and accuracy and wherein the customary wrinkles and other roughness incident to the manufacture of these shells by hand are eliminated.

It is further an object of this invention to provide the mechanism hereinbefore referred to with suitable controlling means whereby different sizes of outer shells may be manufactured with such rapidity and regularity as has been heretofore unattainable.

To the accomplishment of the aforesaid objects this invention consists in the peculiar and novel construction, arrangement, and combination of the various parts hereinafter described, reference being had to the accompanying drawings, forming a part hereof.

In the accompanying drawings, in which similar reference-numerals indicate like parts in the different figures, Figure 1 is a front elevation of the entire machine; Fig. 2, a plan view, enlarged, of the means whereby the beading is placed on the tire; Fig. 3, an end view of the mechanism shown in Fig. 2. Fig. 4 is an enlarged view of a creasing device used in placing fabric in position; Fig. 5, a view showing the means by which power is communicated to the core on which the shell is built up; Fig. 6, a detail of a reciprocating or smoothing device for smoothing the wrinkles out along the sides of the shell while being constructed; Fig. 7, a section at the line *x* of Fig. 6; and Fig. 8, a sectional view of the outer shell of a pneumatic tire, showing one of the forms of tire which this machine is capable of manufacturing.

In the drawings, 1 2 are the upright sides of a frame on which the mechanism hereinafter to be described is mounted. On the upright 2, which may be round or angular, as preferred, is a carriage 3, from which projects at right angles a shaft 4, on which is a hub 5, capable of ready revolution on the shaft 4. From this hub 5 project spokes 6, a portion of which are provided with clips 7 for a purpose to be stated. The outer ends of all these spokes are provided with a flange on one side which serves to hold the inner side of a circular mandrel or core on which the outer shell of the pneumatic tire is built up. This core is preferably hollow for lightness and has the same exterior and conformation that it is desired to impart to the interior of the finished shell. The inner or base portion of this core 8 is held on the ends of the spokes 6 on one side by flanges referred to and on the other side by the clips 7, which are capable of being readily removed when desired.

From the lower end of the carriage 3 depends a threaded rotatable shaft 9, the lower end of which passes through the central portion of a threaded miter-gear 10, which serves as a nut for said shaft and is supported by resting on a bracket 11, bolted to the upright 2. This bracket 11 has also an upright arm 12, through which passes a shaft bearing at one end a miter-gear 13 and at its opposite end a crank-arm 14, by which the rotation of both miters and the ascent and descent of the carriage 3 is attained.

The revolution of the core 8 on the shaft 4 is effected by the following mechanism: Above the shaft 4 and parallel therewith and mounted in suitable brackets 15 on the frame of the machine is a shaft 16. On that part of the shaft 16 immediately above the core 8 is a

spool or roller 17, the central portion of which is concave and made of some suitable substance, such as vulcanized rubber covered with canvas, and the sides or ends of this spool 17 are composed of disks of heavy sole-leather 18.

On the rear portion of the shaft 16 and capable of longitudinal motion thereon is a friction-wheel 19 provided with a hub 20, both of which, together with the shaft 16, being splined to receive a key to compel the simultaneous revolution of said friction-wheel 19 with said shaft 16. A lever 21 is used to change the longitudinal position of this friction-wheel 19 on the shaft 16. It is obvious from the foregoing description that if the elevating-screw 9 is operated to raise the carriage 3 sufficiently to cause a snug engagement between the roller 17 and the core 18 the revolution of the friction-wheel 19 will rotate the core 8.

In order to rotate the friction-wheel 19, the following mechanism is employed: At right angles to the shaft 16 and mounted in brackets 22 on the frame 1 and on a bracket 23, mounted on a cross-bar 24, extending between the uprights 1 and 2, is a shaft 25, bearing a pulley 26, which is designed to receive power from a belt driven by any suitable or preferred source, the nature of which it is not essential to give in this description.

On the end of the shaft 25 adjacent to the friction-wheel 19 is a flat friction-disk 27, arranged to revolve with the shaft 25 and to be forced against and withdrawn from engagement with the friction-wheel 19 and to thereby cause the rotation of the shaft 16.

The shaft 25 is capable of longitudinal movement in its bearings and is actuated toward and away from the shaft 16 by the following means:

On the outer end of the shaft 25 is a cap 28, arranged to slip over the end of the shaft 25 and provided with a set-screw 29, arranged to enter a groove in the shaft 25 near its end, and thereby be retained thereon. In the opposite end of the cap 28 is pivoted, by means of a bolt 30, one end of a bell-crank lever 31, arranged to fulcrum on a bolt 32, passing through a bracket 33, attached to the upright 1. The lower end of this bell-crank is inwardly turned and is attached to a longitudinally-extensible rod 34, to the lower end of which is attached a pedal 25, mounted on pivoted arms 36 and normally kept upward by a spring 37.

From the foregoing description it will be seen that if the peda 35 is depressed the shaft 25 will be inwardly moved, causing the engagement of the friction-disk 27 and the friction-wheel 19.

In order to impart a desired tension or stretch to the rubber-saturated fabric which is to compose the main portion of the shell or outer tube of the pneumatic tire, we provide the following mechanism: On the upright 1 is a bracket 38, held in place by a bolt 39, passing through a slot in the bracket to permit the vertical adjustment thereof. The rear upper portion of this bracket is bifurcated, leaving two upwardly-extending arms 40, across which extends a bolt 41, on which is pivoted one end of a shaft 42, bearing a loose roller 43. Over the rear portion of this roller passes a friction-band 44, capable of being tightened to a desired degree by thumb-nuts 45, so that a desired amount of resistance to its rotation may be imparted to this roller. Immediately below this roller 43 is a similar roller 46, but the shaft of which is rigid and is mounted between the back face of the bracket and an upwardly-turned portion 47, between which the roller rotates. On the front end of the shaft 42, bearing the roller 43, is a boss 48, on either side of the lower ends of which are straps 49, which have mounted between their lower ends a handle 50, having a cam-shaped head arranged to engage a boss 51 on the upright portion 47, the boss 51 being provided on its under surface with a suitable configuration to fit the cam-head of the handle 50.

The object of this arrangement is this. When it is desired to feed fabric to the core, the cam-handle 50 is released from engagement with the boss 51 and the upper roller 43 tilted upward on its pivot 41, permitting the insertion of a piece of fabric between the two rollers. Then the upper roller is lowered and compressed tightly against the lower roller by means of the mechanism just described. Sufficient pressure is then placed on the upper roller by means of the friction-band 44 to give a desired amount of resistance to the rotation of the rollers and the passage of fabric therebetween. From between these rollers the fabric is carried upward onto the core and passes under the roller 17, which smooths its upper surface, and partly down the sides of the core, this last feature being attained by two rollers 52, mounted on yoke-arms 53, pivoted to the upper portion of the bracket 23 and drawn toward each other by an inwardly-contracting spring 54. These rollers 52 have their axes radial to the center of the roller 17 and are arranged to press on the outer sides of the roller 17, which, as has been heretofore described, are made of sole-leather. The combined action of the roller 17 and the side rollers 52 serves to smooth the fabric down over the upper portion of the core and to a considerable distance downward therefrom. The mechanism by which the tire is smoothed from this point to the end of its rounded portion is as follows, reference being had to Figs. 1, 6, and 7, and may be described primarily as a reciprocating pair of fingers which slide up and down along the sides of the fabric on the core and smooth out the wrinkles with such rapidity of motion as to cover all portions of the fabric on the sides of the core during its revolution. Mounted on one portion of the bracket 23 is a small housing con-

sisting of a base and two uprights 55, mounted in which is a shaft 56, capable of rotating therein. In the central portion of this shaft between the uprights 55 is a loose and a tight pulley 57 and 58, over which passes a belt 59 from a pulley 60 on the shaft 25. The position of this belt with reference to the two pulleys 57 and 58 is determined by a belt-shifter 61, held normally in a position to retain the belt on the loose pulley 57 by a spring 62, which may be shifted by means of a bell-crank lever 63, pivoted on a bracket 64 on the cross-bar 24. To the opposite end of this bell-crank 63 is attached a longitudinally-extensible rod 65, to the lower end of which is attached a pedal 66, normally kept raised by a spring 118, so that by depressing the pedal 66 the bell-crank lever 63 will throw the belt-shifter 61 to one side and shift the belt from the pulley 57. On the outer end of the shaft 56 is a crank 67, to the wrist-pin of which is attached a connecting-rod 68, whose upper end is pivotally connected to a lever 69, pivoted on a bolt 70, passing through a post 71, rising from the housing 15, which sustains the shaft 16. This lever 69 is bifurcated except at the point where it passes through the eye of the connecting-rod 68. Also mounted on the bolt 70 is a lever 72, likewise bifurcated its entire length and having extending between its ends a shaft, (not shown but indicated,) which stands immediately above the lever 69. A similar shaft is mounted and pivoted between the sides of the lever 69, and an adjusting-screw 73 extends between these two shafts and is controlled at its lower end by a crank-arm 74, so that the angle between the levers 69 and 72 may be changed at will, and thus the extent of the rocking of the long end of the lever 72 may be accurately determined.

On the lower free rocking end of the bifurcated lever 70 is placed the mechanism by which the sides of the fabric are smoothed around the core, and the mechanism is best illustrated in Figs. 6 and 7. Between the ends of this lever 72 and attached thereto are short arms 75, which are fastened to opposite sides of a head-block 76, which is vertically perforated and arranged to slide upward and downwardly on a guide-rod 77, held firmly in position by a bent arm 78, bolted to any desired or preferred portion of the frame of the machine. On the upright guide-rod 77, below the place occupied by the supporting-arm 78, is a cross-bar 79, to the outer ends of which are fastened by screws or otherwise guides 80. These guides are provided on their outer faces with vertical dovetailed recesses into which fit vertically-reciprocating fulcrum-blocks 81, which are connected by an arch 82, extending between them and inclosing the guide-rod 77. At the lower end of the head-block 76 is a cross-bar 83, to the outer ends of which are pivoted bent levers 84, which depend therefrom and have their lower ends pivoted to the outer ends of shaping or smoothing fingers 85, the pivots of which are bolts in the fulcrum-blocks 81. The lower ends of these fingers 85 are nicely and smoothly rounded and are arranged to slide along the surface of the fabric and to compel the fabric to follow the contour of the core 8. On either side of the guide-blocks 80 are spring-plates 86, arranged to be retained and adjusted in place by screws and to press against the fulcrum-blocks 81 with a pressure to be determined by the work required of the fingers 85. The necessity for these spring-plates or friction-plates 86 is this, that as the head-block 76 rises and falls, carrying with it the cross-bar 83, bent levers 84, and fingers 85, the fulcrum-blocks, which bear the pivots for the fingers 85, would have a constant tendency to fall of their own weight, and obviously as rapidly as the fingers descend, and the fingers would exert no pressure on the fabric at their working ends; but by retarding the descent of the fulcrum-blocks 81 a considerable pressure is required on the outer ends of the fingers 85 to compel their descent, thereby forcing inward with considerably greater force the working or smoothing ends of these fingers. Experience has shown that these fingers work upward and downward with great rapidity, so much so as to cover every portion of the sides of the fabric and smooth out all wrinkles, both great and small, which exist or occur in the bending of the fabric around the core. After passing this smoothing device the fabric must then be tucked into a crease which exists near the lower end of the core and forced there with considerable pressure to cause it to adhere until it is desired to remove the finished shell from the core. This creasing of the fabric in the manufacture of tires is known to the trade as "stitching." The mechanism for stitching by forcing the fabric into this crease or depression is as follows and is shown in Figs. 1 and 4: From a suitable part of the frame of the machine extends a supporting-arm 87, the shape and configuration of which and its adjustment to the frame being of secondary consequence in the construction of this device. At its outer or free end it is provided with a bolt 88, which forms a pivot for a bifurcated arm 89, between the sides of which are pivoted two curved arms 90, the lower ends of which are inturned and are provided with sharp-edged rollers 91. At the upper ends of these arms 90 are attached links 92, arranged to cross each other and be pivotally fastened to a lever 93, provided at one end with a handle for the grasp of the operator and at the other end pivoted to a link 94, which in turn is pivoted to the bifurcated arm 89. This device is only used at intervals in the placing of the fabric on the core, and hence when not in use may be raised by simply raising the handle, which swings apart the lower ends of the arms 91, releasing them from engagement

with the fabric, and the whole device swings upward on the pivot-bolt 88 out of the way of the other mechanism of the machine.

In the construction of outer shells for heavy pneumatic tires it is customary to use a beading as a basis for forming a barb or grasping projecting on the lower portions of the shell to permit the inturned or clenching edges of the metallic tire of the vehicle to hook into, and this beading usually is made in a continuous strip with a hard soft-rubber core. By this is meant a rubber of such hardness as to be nearly as hard as what is known as "hard rubber," but still to retain sufficient inherent elasticity and flexibility as to permit its being bent and curved without cracking or breaking. This core is then surrounded by one or more layers of rubber-saturated fabric and placed against the sides of the fabric on the core. It is then covered by repeated layers of fabric and the whole united during vulcanization. In order to place this beading upon the sides of the fabric, which we will suppose to have been already placed upon the core, the following mechanism is used: On the side of the carriage 3 which sustains the core is a boss 95 into which is inserted and held by any preferred means a shaft 96. (See Figs. 1, 2, and 3.) This shaft 96 is designed to form an angle with the upright 2 of about sixty-three degrees and should be radial to the center of the shaft 4. On this shaft 96 is a slidable carriage 97, splined thereto. The retention of the carriage 97 on the shaft 96 at a desired point is obtained by means of a screw 98, operated by a hand-wheel 99. Projecting at right angles to the shaft 96 from the carriage 97 is a splined shaft 100, on which are mounted hubs 101 of long sleeve-like bearings 102, through which extend shafts. (Not shown, but indicated by dotted lines.) On the front ends of these shafts, inclosed in the sleeves 102, are fastened eccentric heads 103, and mounted on these heads 103 eccentric to the center of the shafts in the sleeves 102 are rollers 104, having the configuration of the outside of the beading to be placed on the shell in its construction. Between the hub 101 on the shaft 100 is another hub 105, which has depending from its rear face an arm to the lower end of which is pivoted on a substantially horizontal pin an elongated rocking plate 106, to which is attached a handle 107, by which it is rocked. From the face of this rocking plate 106 project two rotatable pins 108, for a purpose to be described. On the rear ends of the shafts inclosed in the sleeves 102 are depending crank-arms 109, and each has projecting from its lower end rotatable pins 110. The pins 110 and 108 are connected by adjusting-screws 111, having on their outer ends milled heads by which they may be rotated. These adjusting-screws 111 pass freely through the pins 110 and mesh into the pins 106, so that by revolving them the relative positions of the two crank-arms 109 to each other may be determined, which also determines the position of the grooved rollers 104 with reference to the core 8. Surrounding the adjusting-screws 111 are springs 112 to keep the crank-arms 109 normally thrown apart. Depending from the under faces of the sleeves 102 are brackets 113, having perforated heads, through the perforation of which the beading to be affixed to the tire is fed, thereby accurately feeding it into position, and as this perforation is a close fit for the beading it serves to prevent it from dropping to the floor when the beading mechanism is removed from operative connection with the core. On each of the hubs 101 and 105 are set-screws by which their positions may be fixed when determined. On the shaft 96 I customarily place a collar 114, held in a desired position by a set-screw or other preferred means with a view to regulating the position of the carriage 97 definitely and quickly when desired. Of course it is obvious that for different sizes of tires the position of the collar 114 will be varied to meet the requirements of the case. The operation of this bead-placing mechanism is as follows: Assuming that sufficient fabric has been placed on the core and the shell is in a proper condition to receive the beading and the parts are in the position shown in Fig. 1, with strips of indefinite length of beading in the guides 113, the screw 98, retaining the carriage 97 in place, is released and the carriage pushed forward toward the core until it encounters the collar 114. In doing this it is necessary to swing apart the rollers 104, so that they will pass around the main cylindrical portion of the fabric-covered core. As soon as the carriage 97 encounters the sleeve 114 the screw 98 is tightened and the handle 107 thrown to the position shown in Fig. 3, thereby pressing the rollers against the sides of the fabric at the proper place where it is desired to place the beading. The beading is then pushed upward and placed between the rollers 104 and the fabric on the core and the pedal 35 depressed, throwing the friction-disk 27 against the friction-wheel 19, causing the revolution of the core, and as it it revolves the bead on both sides of the core is fed onto the fabric and compressed there by the force of the rollers 104 until a complete revolution of the core has taken place, at which time the beading is severed from the continuous strip, the ends of the beading are nicely matched, the handle 107 swung a quarter of a revolution, throwing the rollers 104 away from the core, the screw 98 released, and the carriage 97, with its accompanying mechanism, swung out of the way, after which the placing of fabric on the partially-constructed tire is continued.

In Fig. 8 is shown one form of an outer shell which may be constructed on this ma-

chine, and the description of the process by which this shell is constructed will serve to illustrate the general construction of all tires which are to be made thereon. The first strip of fabric 15 is of sufficient width so that when fed onto the core the lower edges after being creased by the creasing-wheels 91 will lie on the flat portion of the core throughout the entire circuit thereof and of sufficient length to overlap a distance necessary to insure a perfect union between the two ends thereof. Next it is customary to place on the first fabric 115 a second layer 116, with the grain or warp thereof crossing the warp of the first layer, whose width is such as to just enter the crease between the outer portion of the core and the flat portion. After this beading is placed in position, as just described, then the lower edges of the first strip of fabric 115 are folded up around the beading and pressed against the inclined sides of the second strip of fabric 116 and caused to adhere thereto by the sticky nature of which it is composed. Then a third strip of fabric 117, of such a width as to extend down to the intersection of the beading with the shell, is placed on said second strip 116, and thereby covers the reflected ends of the first strip. Any preferred or desirable number of strips may be placed thereon, following this operation until the shell has acquired a desired thickness. Over this is placed a coating of rubber with a thickened portion on what will be the tread portion.

The core is removed from the spokes 6 by releasing the clips 7 and is taken to the vulcanizer and after being inclosed in a mold is properly vulcanized, after which the shell is stripped from the core by hand, this being easily accomplished by reason of the elasticity of the shell. The core is then returned to the machine and the process repeated.

What we claim, and desire to secure by Letters Patent, is—

1. The combination in a machine of the class specified of a tension device to simultaneously smooth and flatten strips of fabric, a revoluble core to receive said strips from said device, means to form said strips approximately longitudinally about said core and means to regulate the tension on said feeding device.

2. A machine of the class specified consisting of revoluble means to support the article to be built while in the process of manufacture and means for creasing or stitching portions of said article on said revoluble means.

3. A machine of the class specified involving revoluble means to sustain the article to be made during the construction and means for placing simultaneously suitable strips of beading on both sides of said article while on said revoluble means.

4. A machine of the class specified consisting of revoluble means to sustain the article while in construction, means to regulate the tension of the various parts of the article while being fed onto said revoluble means, means to smooth various portions of said article, means to crease or stitch said article and means to place strips of beading on said article while mounted on said revoluble means.

5. A machine of the class specified involving revoluble means for sustaining the article under construction, means to revolve said sustaining means, said last-named means being arranged to smooth certain portions of said article.

6. The combination in a device of the class specified of a revoluble core to sustain the article under construction, and a friction-roller adapted to transmit motion to said core and simultaneously smooth a certain portion of the article during said revolution.

7. The combination in a device of the class specified of a revoluble core to sustain the article while under construction, frictional means to bear on the article and revolve said core, means to feed material to said core, devices for smoothing material while on said core, and means to regulate the position of said revolving core with relation to said smoothing mechanism.

8. The combination in a device of the class specified of a revoluble core to sustain the article during construction, a carriage adapted to slide toward and away from said core, suitable mechanism mounted on said carriage to place suitable beading on the side of said article during construction of said article.

9. The combination in a device of the class specified, of a revoluble core to sustain the article while under construction, of reciprocating mechanism involving fingers to press and smooth the sides of said article while sustained on said revolving means.

10. The combination in a device of the class specified of a revoluble means to sustain the article while being constructed, of reciprocating means involving smoothing-fingers to work substantially radially to said supporting means and smooth the sides of said article while on said revoluble means, and means to regulate the stroke of said reciprocating means as desired.

11. The combination in a device of the class specified of a revoluble core to sustain the article while under construction, a roller to smooth the outer portion of the article while on said revolving means, said roller being provided with flexible sides, spring-pressed rollers to bear on said flexible sides to smooth a portion of the sides of said article during its revolution.

12. The combination in a machine of the class designated of a revoluble core to sustain the article while being constructed, a slidable carriage arranged to move toward and away from said core, shafts mounted in said carriage bearing eccentrically-pivoted rollers capable of placing a beading on the sides of said

article, and means to rock said shafts and throw said rollers toward and away from the article while on said revolving means.

13. The combination in a machine of the class designated of a revoluble core to sustain the article while being constructed, a slidable carriage arranged to move toward and away from said core, shafts mounted in said carriage bearing eccentrically-pivoted rollers capable of placing a beading on the sides of said article, means to rock said shaft and throw said rollers toward and away from the article while on said revolving means, and guides to direct and sustain strips of beading fed to said rollers.

14. The combination in a machine of the class designated of a revoluble core to sustain the article while under construction, a frame capable of being swung toward and away from said article, inwardly-movable arms on said frame, creasing-rollers on said arms and mechanism to force said creasing-rollers against a desired portion of said article while being constructed.

In testimony that we claim the above we hereunto set our hands in the presence of two subscribing witnesses.

FRANK A. SEIBERLING.
WILLIAM C. STEVENS.

In presence of—
C. E. BINGHAM,
GEO. W. ROGERS.

Defendant's Exhibit L—Moore Patent.

(No Model.)

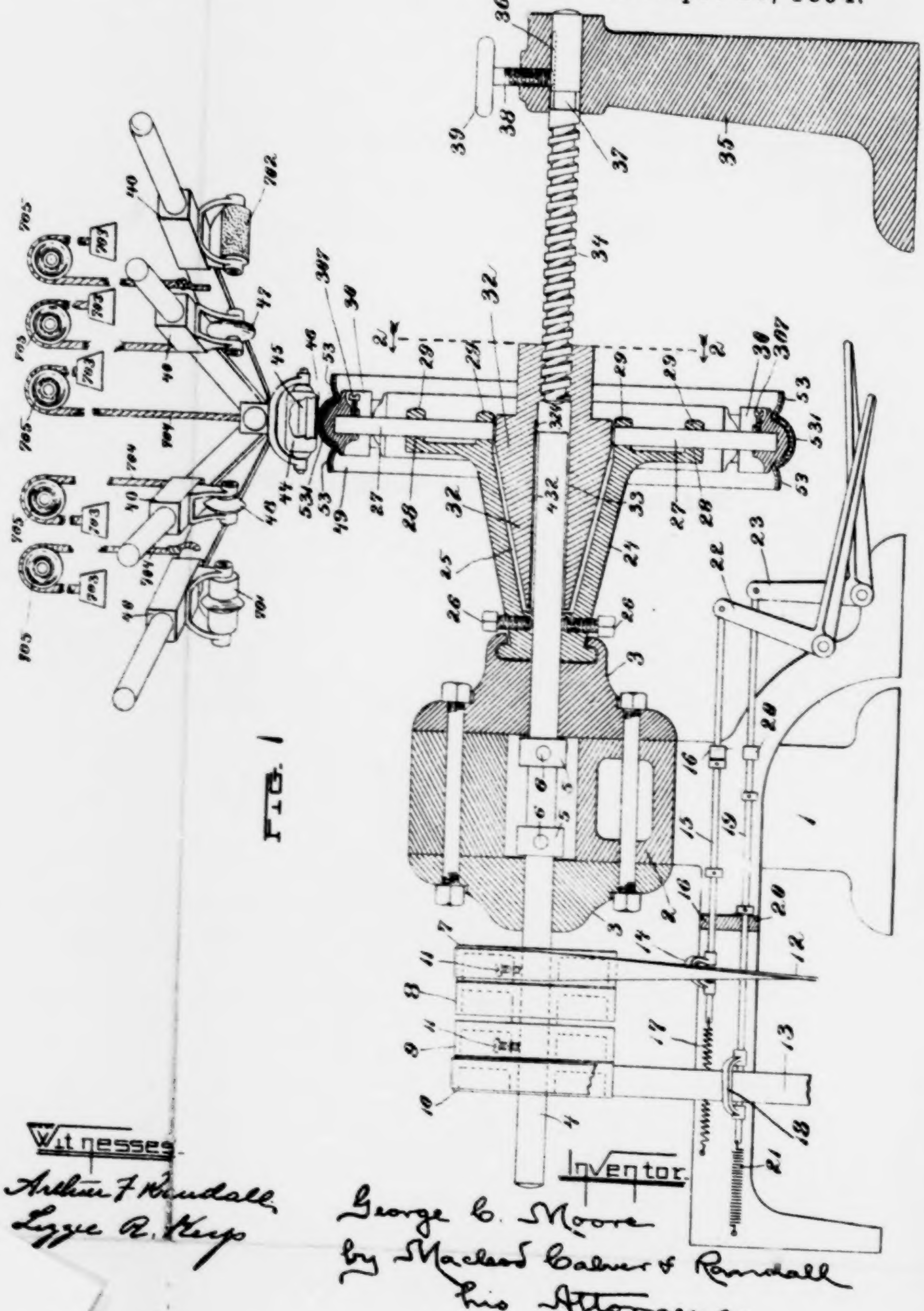
3 Sheets—Sheet 1

G. C. MOORE.

MACHINE FOR MAKING SHOES OR COVERS FOR PNEUMATIC TIRES.

No. 518,112.

Patented Apr. 10, 1894.



Witnesses

Arthur F. Randall

Lizzie R. Kemp

Inventor.

George C. Moore

by Macleod Calver & Randall

his Attorneys.

(No Model.) 3 Sheets—Sheet 2.

G. C. MOORE.

MACHINE FOR MAKING SHOES OR COVERS FOR PNEUMATIC TIRES.

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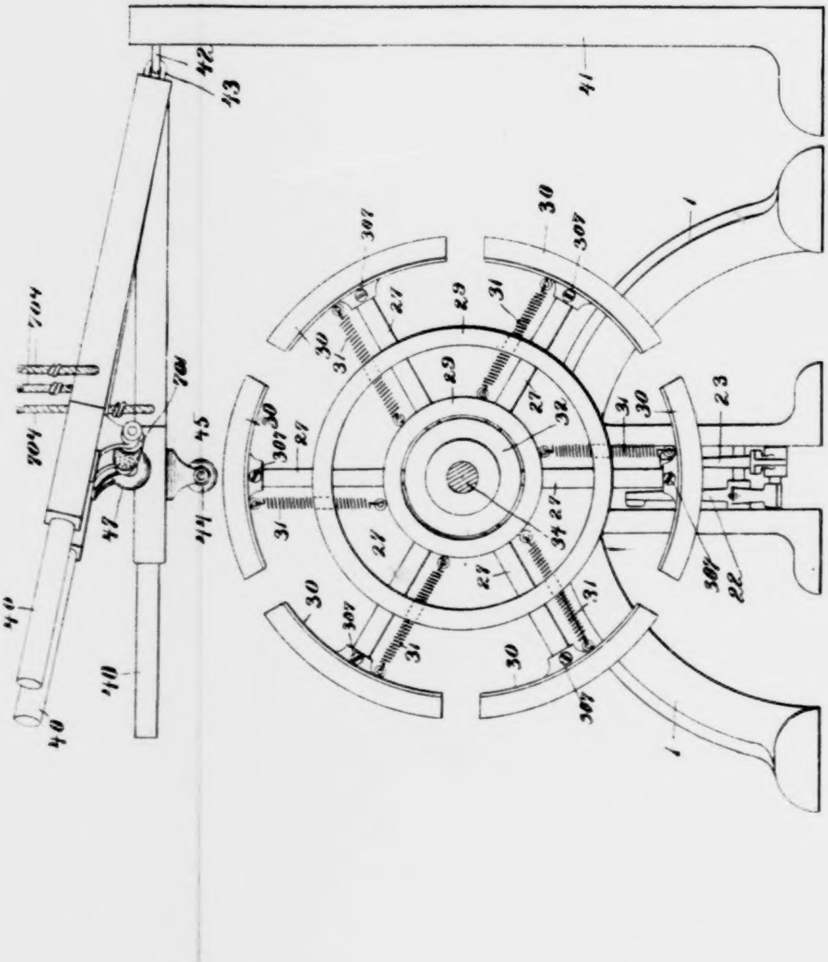

FIG. 2.

Witnesses.
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Lizzie R. Keys

Inventor.
George C. Moore
by Macleod Calver & Randall
his Attorneys

(No Model.)

3 Sheets—Sheet 3.

G. C. MOORE.

MACHINE FOR MAKING SHOES OR COVERS FOR PNEUMATIC TIRES.

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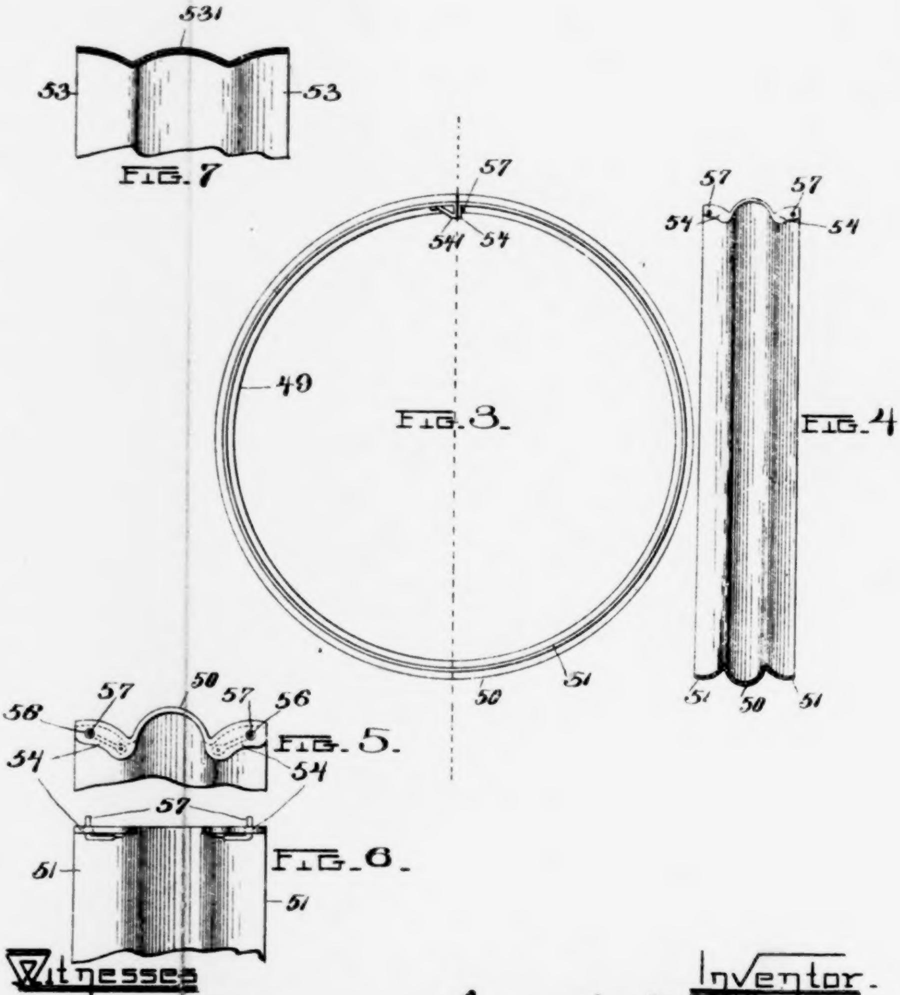

Witnesses

Arthur F. Randall

Robert Wallace.

Inventor.

George C. Moore

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his Attorneys

UNITED STATES PATENT OFFICE.

GEORGE C. MOORE, OF EASTHAMPTON, MASSACHUSETTS.

MACHINE FOR MAKING SHOES OR COVERS FOR PNEUMATIC TIRES.

SPECIFICATION forming part of Letters Patent No. 518,112, dated April 10, 1894.

Application filed December 5, 1893. Serial No. 492,828. (No model.)

To all whom it may concern:

Be it known that I, GEORGE C. MOORE, a citizen of the United States, residing at Easthampton, in the county of Hampshire and State of Massachusetts, have invented certain new and useful Improvements in Machines for Making Shoes or Covers for Pneumatic Tires, of which the following is a specification, reference being had therein to the accompanying drawings.

The object of my invention is to provide a machine on which the shoes or covers of the pneumatic tires used on the wheels of bicycles, &c., may be conveniently and expeditiously manufactured.

The invention consists in certain novel features of construction and combination, and will first be described with reference to the accompanying drawings, after which the features thereof will be particularly pointed out and distinctively defined in the claims at the close of this specification.

The accompanying drawings show the best form of my machine which I have yet devised, but it is to be understood that various changes may be made therein without departure from the spirit of my invention.

In the drawings, Figure 1 is a view of my machine mainly in central longitudinal section. Fig. 2 is a view in vertical section on line 2—2 Fig. 1, looking toward the left in the latter figure, the shell being removed from the expanding former. Fig. 3 is a view in side elevation of the shell. Fig. 4 is a view of the shell in vertical section on line 4—4 Fig. 3, looking toward the left in the latter figure. Figs. 5 and 6 are views showing details of the shell. Fig. 7 is a view indicating the character of the lining fabric that I may use.

The illustrated form of my machine is constructed as follows:

At 1 is the frame supporting the main part of the said machine. The said frame has an upwardly extending portion 2 to the opposite sides of which are bolted boxes 3, 3, which are formed or provided with bearings for the horizontal shaft 4. On this shaft 4 between the boxes 3, 3, there are mounted collars 5, 5, which are secured in place on the shaft by clamping screws 6, 6, and serve by rotating in contact with the inner faces of the boxes 3, 3, to prevent movement of the shaft lengthwise in either direction. Any other approved means of preventing endwise movement of the shaft may be employed, if desired. On one end of the said shaft are mounted four band pulleys 7, 8, 9, 10, two of which, namely those marked 8 and 10 are loose upon the shaft, and free to turn thereon, while the remaining two pulleys, namely those marked 7 and 9 are fast on the said shaft, being secured thereto by clamping screws 11, or any other suitable means. To these pulleys are applied the driving bands 12 and 13, the band 12 being crossed, while the band 13 is straight or uncrossed. The crossed band passes through a loop 14 on the sliding shipper bar 15, which is supported and moves in guides 16, 16 on the frame work, and is held normally in the position which retains the said crossed band on the loose or idle pulley 8 by means of a spring 17, one end of which is connected with the said shipper bar, while the other end thereof is connected with the said frame work. The straight or uncrossed band 13 passes through a loop 18 on the second shipper bar 19, which is mounted in guides 20, 20, on the said frame work with capacity to move endwise therethrough, said shipper bar being normally held in position to retain the said straight or uncrossed band on the loose or idle pulley 10 by means of the spring 21 having one end thereof connected with the said shipper bar 19 and the other end thereof connected with the frame-work. The shipper bar 15 is connected with or engaged by a treadle or foot operated lever 22, and the shipper bar 19 is in like manner connected with or engaged by a second treadle or foot lever 23. By the pressure of the foot of the operator upon either of these treadles or foot levers, the corresponding shipper bar may be drawn endwise in opposition to the action of the spring connected thereto to shift the driving band which is controlled thereby from the loose or idle pulley around which it passes normally, onto the adjacent fast pulley, in order thereby to occasion the turning of the shaft 4 in the desired direction. To the end of the shaft 4 opposite that on which the band pulleys aforesaid are mounted is applied the head or hub 24. The said head or hub has a tapering chamber 25 formed therein and extending throughout substantially the length

of the head or hub, and is fixed or secured at its inner end to the shaft 4, as by means of clamping screws 26, 26, passing through the said inner end and taking bearing by their points against the surface of the shaft 4. The end of the shaft 4 projects to the outer end of the head or hub 24, and on the disk at the outer end of the said head or hub radial squared arms 27, 27 are mounted to slide toward and from the center of the said head or hub in guides formed on or applied to the latter. I have shown the said guides constituted by holes 28, 28, formed in two rings or flanges 29, 29 on the said disk. The said arms 27, 27 have applied to their outer ends segments 30, 30, sockets on the segments receiving the outer ends of the said arms, and the segments and arms being adjustably clamped together by means of screws 307, as shown; and the arms and segments are drawn toward the center of the head or hub, and of the shaft, by means of springs 31, 31 which are connected at their outer ends to either the segments as shown, or to the arms, and at ther inner ends are connected to some fixed part of the head or hub. The segments 30, 30 together constitute an expansible ring-shaped former, and the action of the springs is to draw the parts toward the center and contract it into the smallest dimensions.

At 32 is shown a tapering or cone-shaped block fitted to pass into the interior of the head or hub 24, the said block or cone having a central opening or hole 33 therethrough which, throughout at least the greater portion of its length, is of dimensions suitable to receive the end of the shaft 4, onto which the said block or cone is intended to be passed. When the said block or cone is passed into the interior of the head or hub the inner ends of the arms will be held in contact with the outer surface thereof by means of the springs 31, 31. Said block or cone constitutes an expander, and is intended to be moved gradually into the hub so as to force the arms and segments outwardly to increase the diameter and circumference of the expansible former, or be withdrawn so as to permit said arms and segments to be moved inward toward the center under the action of the springs 31, 31, in a manner to contract the diameter and circumference of the said expansible former. At its outer end the hole or passage 33 through the block or cone is threaded to fit the screw or threaded rod 34. The said screw or threaded rod is held by one end thereof, which is not threaded, in a stand 35 which is provided with a bearing for the reception of the said end. In the said end there is formed a longitudinal groove 36, and, also at the inner end of the said longitudinal groove, an annular groove 37, with which the said longitudinal groove 36 communicates. A clamping screw 38 having a hand-wheel 39, or suitable handle, at its outer end is fitted to a threaded hole in the said stand, and its inner end enters the annular groove 37 and longitudinal groove 36 as desired, and as will presently be explained.

At 40, 40 are levers, which, at their inner ends are loosely mounted or joined to an elevated support. The said support 41 has projecting therefrom a staple or half-ring 42 and each of the levers 40 has projecting from its rear end an eye 43 which is fitted onto the said staple. The described mode of connecting the levers with their support enables the said levers to be moved freely up and down as required, and to be slid laterally as may be desired in order to bring the required one thereof over the working point on the expansible former. A series of rollers or other implements is mounted on the said levers, one roller or the like to each lever, they being employed in the operations by which a tire is produced. The roller marked 44 is composed of a central shaft 45 and has an air-tight cylindrical casing 46 surrounding the said shaft except at the ends thereof, the said casing being filled with air and constituting what may be termed a pneumatic roll. The roller marked 47 is of wood, while the thin or disk-like roller 48 is of metal.

At 49, see Fig. 3, is shown a shell constituted by a ring of sheet metal which is severed or split at one point. This shell is intended to have the lining applied thereto, and is shaped properly in cross section. The shell shown in the drawings has an intermediate or middle curved portion or body 50 which, in cross section, may be made as part of a circle, and on each side thereof there is a curved wing 51. The shell is shown made of this shape in cross section in order to conform to the special form of lining fabric which is represented in the drawings, although it may be of any other desired and approved shape. The said illustrated lining fabric is woven with the middle or body part 531 and the wings 53, 53 on opposite sides thereof. At the meeting ends of the shell the said wings 51, 51, thereof are formed with inwardly extending projections 54, 541. These projections 54, 541, are perforated as at 56. To the projections marked 54 are applied catches 57, each consisting of a piece of spring wire, which is secured at one end to the lateral face of the corresponding projection, and has the other end bent to form a pin, which projects through the hole in the said projection, and is intended to pass into the similar hole in the opposite projection when the two projections are brought into the position which is shown in Fig. 3.

In making a shoe or cover for a pneumatic tire, I first take the shell and place it on the expanding former constituted by the segments. Prior to thus applying the shell to the expanding former, the latter has been caused to contract to its smallest dimensions by effecting, in a manner which will be made to appear more clearly hereinafter, the withdrawal of the expanding device constituted by the block or cone. When thus applied,

the ends of the shell overlap each other to some extent. A piece of lining fabric or material having been made into the form of an endless ring by means of cement or sewing is then put on the shell. Next, the screw or threaded rod and cone are advanced together by hand, or otherwise, as may be provided for, until the forward or small end of the cone has passed over the proximate end of the shaft, and the groove 324 in the interior of the cone has received the spline 432 on the said shaft. To permit the parts thus to be advanced, the clamping screw must first be turned slightly so as to relieve its pressure upon the screw or threaded rod 34 and leave the latter free to be moved endwise through the bearing provided therefor. As the said screw or threaded rod is thus moved the end of the clamping screw enters the longitudinal groove 36, and while the said end remains in the said longitudinal groove the screw or threaded rod is held from rotating, although remaining free to move endwise. The forward end of the expander cone having been introduced within the series of radial arms and engaged with the end of the shaft, the said clamping screw is turned to cause its inner end to bear with slight pressure against the bottom of the longitudinal groove in the screw or threaded rod in order to hold the latter from moving endwise until the force tending to occasion such movement exceeds the holding power of the screw. So long as the inner end of the said screw remains in the said longitudinal groove the screw or threaded rod will be prevented from rotating. By pressure of the foot applied to the treadle or lever 22 the shipper 15 is moved in a direction to shift the crossed belt onto the fast pulley 7. This causes the shaft 4 to be revolved in one direction, it carrying around with it not only the head or hub, and the expanding former carried thereby, but the expander cone. As the latter rotates in unison with the shaft and turns upon the non-rotating screw or threaded rod, its engagement with the thread of the latter causes the expander cone to be moved endwise into the chamber 25 of the head or hub 24, its tapering exterior acting to force outward gradually the arms 27 and the segments, thereby expanding the expansible former and the shell which surrounds the latter so as to stretch tightly the endless ring of lining material or fabric which has been applied to the said shell. When the advancing end of the expander cone comes into contact with the stop constituted by the inner end of the chamber within the head or hub its forward movement is brought to an end, the expansion of the former and parts applied thereto having been effected to the desired extent, and thereafter, inasmuch as the cone cannot advance, it presses rearwardly the screw or threaded rod 34, overcoming the friction of the clamping screw, the inner end of the clamping screw sliding in the longitudinal groove until the annular groove is presented to the inner end of the said clamping screw. When the said annular groove comes opposite to the clamping screw the screw or threaded rod becomes free to rotate in unison with the other parts and its endwise movement terminates, although the rotation is kept up at a high rate of speed during the performance of the operations which now are proceeded with. As the former expands, the overlapping ends of the shell slide upon each other until the expansion is completed, whereupon the said ends abut, the projections 54, 541, resting against each other as indicated in Fig. 3. When in this position the spring-catches 57, 57, which are now permitted to pass through the holes 56 in all of the said projections, serve to prevent the ends of the shell from slipping or moving sidewise on each other. While the parts continue to rotate, the cement is applied to the surface of the lining material or fabric and distributed uniformly by means of the roll 701, a suitable scraping knife being first applied, if desired. The cement employed consists of rubber and naphtha, mixed sometimes with a small proportion of benzine. The said roll has cylindrical portions for working upon the raised portions of the lining and a narrow raised portion for entering the depressions or angles. If desired a non-extensible twine or yarn, or suitable wire may now be wound on the lining at each side of the middle portion. Then the shell is removed and placed in a dry-room to partly dry the lining and thereby create the desired adhesive condition of the cement.

The removal of the shell is effected as follows: The distribution of the cement having been effected, the pressure upon the treadle or foot lever 22 is released and the spring 17 is permitted to move the shipper bar 15 in the reverse direction and carry the crossed belt from the fast pulley 7 to the loose pulley 8. The clamping screw is now turned down a little tighter against the screw or threaded rod and the treadle or foot lever 23 is pressed upon so as to move the shipper bar 19 in a manner to transfer the straight or uncrossed belt from the loose pulley 10 onto the fast pulley 9. This will rotate the shaft and parts moving in unison therewith in a direction which is the opposite of that in which they before were moved, and will thus cause the expander cone to move in the reverse direction along the stationary screw or threaded rod and thus gradually withdraw it from the interior of the head or hub. As the expander cone is withdrawn the arms or segments will be moved inward gradually so as to contract the expansible former. When the rotation of the parts has been continued long enough to disengage the expander cone from the end of the shaft, the pressure upon the treadle or foot lever 23 is released and the band 13 is permitted to pass onto the loose pulley 10. Then the clamping screw is turned out so as to withdraw its end from the annular groove of the screw or threaded rod 34, and

the latter is pushed outward slightly by hand or otherwise as may be provided for, so as to leave a free space between the end of the shaft and the side of the expansible former sufficient to permit the shell to pass therethrough in being taken away from the machine. The shell, which remains of the full size to which it was expanded, is now removed and taken away from the expansible former, and is set aside in a dry-room until the rubber has set set upon the lining fabric or material, after which the shell is applied again to the expansible former and the succeeding operation in the manufacture of the shoe or cover is performed. In the case of the lining fabric shown in the drawings it is intended to apply the shell having such a lining fabric thereon to the expansible former two more times in succession. The second time it is thus applied, which is after the cement has set as above noted, the wings of the lining are turned down onto the intermediate or middle portion to form the tread, the rolls 47 48, being successively brought into action, smoothing and stretching the said wings into proper position and condition, the narrow roller working into the angles of the shell. Then the pneumatic roller 44 is brought into action to even up the lining and expel air from between the layers. Another coating of cement is applied to the surface and the shell is removed and again placed in the dry-room to allow such coating to set. After the said coating has set, the shell is for the third time placed on the expansible former for the purpose of having the rubber covering put on, the latter being composed usually of sheet rubber. The pneumatic roller is used on the rubber covering to expel air and work the same into proper place and position. It is not intended to remove the lining fabric or lining from the shell after having been applied thereto, until the same is finished and thoroughly set.

The twine, yarn or wire which is inclosed between the layers at the lines of the folds serve to give strength and to form beads or ridges as customary in bicycle tires.

The felt covered roll 702 is used in spreading and working the different coatings of cement. Mounting the different rollers upon different levers as shown enables the desired one to be forced readily with the desired degree of pressure against the lining carried by the shell and mounted upon and rotating with the expansible former. I have shown the levers as normally raised out of the way by means of weights 703, the latter being attached to the ends of the cords 704 which pass around rollers 705, suitably mounted in an elevated position, said cords being attached at their opposite ends to the respective levers. By means of the said weights and cords the levers normally are held lifted but any one of them may be grasped and easily brought down in position to present its roller to the lining on the shell. In consequence of be[illegible]g movable freely laterally the levers may be swung laterally to bring the desired one with its particular roller over the rotating former.

I claim as my invention—

1. The combination of an expansible shell constituting a holder and support for the lining or foundation, with an expansible former to which the said shell is applied, means for supporting and rotating the said former, and means whereby the said former is expanded to also expand the said shell and stretch the lining or foundation applied thereto, substantially as described.

2. The combination of an expansible shell constituting a holder and support for the lining or foundation, and a catch for retaining the parts of the same in proper position when expanded, with an expansible former to which the said shell is applied, means for supporting and rotating the said former, and means whereby the said former is expanded to also expand the said shell and stretch the lining or foundation applied thereto, substantially as described.

3. The combination of an expansible holder and support for the lining or foundation, with means for expanding the same to extend and stretch the said lining or foundation first placed around the same, and for supporting and rotating the same, and rolls for operating on said lining or foundation while applied to and rotating with the said holder and support, substantially as described.

4. The combination of a holder or support for receiving and holding distended the lining or foundation, and means for supporting and rotating the same, of a pneumatic roll for operating on said lining or foundation while applied to and rotating with the said holder and support, substantially as described.

5. The combination with a driving shaft, means for rotating the same in either direction as desired, an expansible former rotating with said shaft, an expander constructed to be engaged and rotated in unison with the said shaft and former when placed in operative connection with the said former, and a screw operating to feed the expander when the latter is rotated, substantially as described.

6. The combination with a driving shaft, means for rotating the same in either direction as desired, an expansible former rotating with said shaft, an expander cone engaged by the said shaft, when said cone is placed in operative position, and thereby made to rotate with the said shaft and former, a feed screw engaging with the said cone and serving to move the latter endwise as required in varying the dimensions of the said former, and means for holding the said screw from rotation while the cone is feeding endwise in either direction, substantially as described.

7. The combination with a driving shaft, means for rotating the same in either direction as desired, an expansible former rotating with said shaft, an expander cone engaged by the said shaft, when the said cone is placed

in operative position, and thereby made to rotate with the said shaft and former, a feed screw engaging with the said cone and serving to move the latter endwise as required in varying the dimensions of the said former, the said screw having a longitudinal groove and a communicating annular groove, substantially as described, a support for the outer end of the said screw, and a locking screw adapted to enter said grooves, substantially as described and for the purposes set forth.

8. The combination with a rotating support or holder for the lining or foundation, of a series of working rollers or implements, a series of levers supporting the said rollers or implements and movable vertically to carry the latter toward and from the said support or holder and also movable laterally to enable the desired one to be brought into working position, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE C. MOORE.

Witnesses:

CHAS. F. RANDALL,

WM. A. MACLEOD.

Defendant's Exhibit M—Jeffery Patent.

No. 607,245.

Patented July 12, 1898.

T. B. JEFFERY.

PNEUMATIC TIRE.

(Application filed Jan. 12, 1894.)

(No Model.)

Fig. 3.

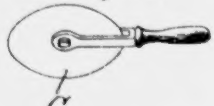


Fig. 1.

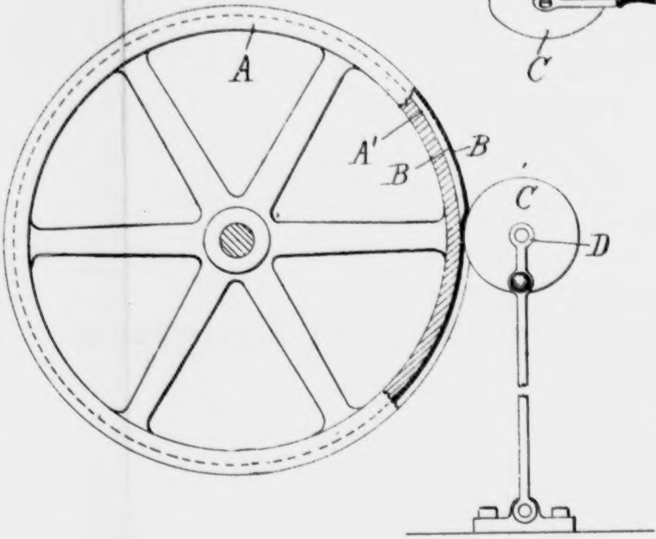


Fig. 2.

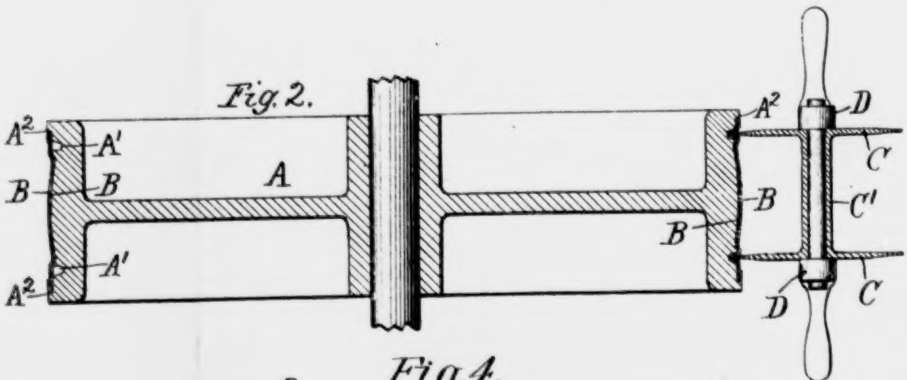
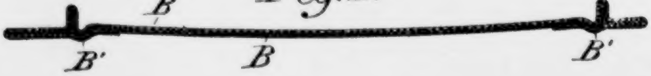


Fig. 4.



Witnesses.
E. T. Wray.
J. Elliott

Inventor.
Thos. B. Jeffery.

UNITED STATES PATENT OFFICE.

THOMAS B. JEFFERY, OF CHICAGO, ILLINOIS.

PNEUMATIC TIRE.

SPECIFICATION forming part of Letters Patent No. 607,245, dated July 12, 1898.

Application filed January 12, 1894. Serial No. 496,582. (No model.)

To all whom it may concern:

Be it known that I, THOMAS B. JEFFERY, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Pneumatic Tires and Processes of Making the Same, which are fully set forth in the following specification, reference being had to the accompanying drawings, forming a part thereof.

This invention relates to the making of the covers or sheaths which constitute the outer portions of tires, commonly called "pneumatic," for vehicle-wheels, being adapted to inclose a disengageable rubber core, which, being inflated, fills the sheath and constitutes the air-cushion within it. Such tire sheaths or covers when applied to the wheel-rim and in use on the wheel with the core inflated are substantially circular in cross-section, as if a length of tubing had been wrapped around the periphery of the wheel and its ends joined, although a rift or opening is usually made at the inner circumference, so that the inflatable core may be placed within the sheath before the entire tire thus made is secured on the wheel-rim. The sheath, therefore, being in its condition of use substantially a rifted tube, it has been customary heretofore in making such sheaths to mold them—the material being rubber or rubber-saturated fabric—in substantially the form in which they will appear on the rim. In my improved process I depart from this method by making the sheath in the form of a flat band or short cylinder whose diameter is substantially that of the wheel which it is to fit and whose length or height is the circumference or outer measurement in transverse plane of the tire, and the cylindrical or tubular form which the tire-cover is to assume on the wheel is given to it merely by folding the lateral edges of such cylinder inward to their seats in the wheel-rim. Such tire-covers are in many of their forms arranged to be secured to the rims of the wheels by means of lateral beads or lips projecting from the tire-cover adapted to engage with suitable projecting lips forming recesses to receive the beads of the cover in the rim, and my process in detail is adapted to produce tire-covers of this description. For making such a tire-cover I provide, first, a pulley or wheel of substantially the diameter of the vehicle-wheel for which the tire is designed, and in its face I form grooves corresponding to the size of the tire measuring over the outside from bead to bead. This distance is usually within a small fraction (one-sixth to one-quarter) of the entire circumference of the tire. Upon this wheel I wrap a strap, or as many straps as may be desired, of fabric suitable for the tire-sheath, using, as is customary for such purpose, preferably a fabric which is saturated or charged to a suitable degree with rubber gum, rendering it adhesive, so that it adheres both to itself and to the wheel. This fabric I stretch or depress into the grooves described by the use of a suitable tool, and subsequently apply any covering or filling of rubber or other material which may be desired to give body to the sheath. The forming-wheel may be made of metal, and the tire-cover thus formed upon it may be vulcanized thereon by exposing the wheel containing it to proper temperature, and it may then be removed from the wheel, being readily stretched after vulcanizing enough to relieve it from the grooves mentioned.

In the drawings, Figure 1 is a side elevation of a drum or pulley and coöperating wheel used in my improved process, a portion of the drum being broken out to show the tire-cover in section thereon at a certain point. Fig. 2 is a section through the axes of the drum and coöperating wheel. Fig. 3 is a perspective of a hand-tool which may be used in lieu of the coöperating wheel shown in the other figures. Fig. 4 is a section transversely across the tire-cover, substantially full size, showing a detail modification for insuring permanence in the lugs.

A represents the forming-wheel, mounted on suitable bearings and having the grooves A' A' in its face.

B B represent layers or bands of fabric for the tire-cover applied about the face of the wheel A covering the grooves. One of these bands is wider than the other and has the excess extending on either side folded back over the edges of the first, so that the edges of the tire-cover, when formed, are folded edges and not raw. These bands B B are made of fabric cut bias, so that it is adapted

to be stretched down into the grooves in the wheel, as described, without danger of being ruptured in the process, and being, as indicated, saturated with adhesive gum when it is forced or stretched into the grooves, as described, it adheres therein, forming beads or ridges which tend to be permanent. This tendency is furthered by the fact that the two layers of bias fabric in slipping upon each other as they are stretched into the groove and adhering to each other at the positions to which they are stretched prevent each the other from returning if there were any natural tendency to return to the original flat form of the fabric. This tendency to permanency in the ribs or beads thus produced may be made complete and permanency of the beads positively secured by applying another strip or band of adhesive fabric outside the first after the grooves have been filled by depressing the fabric of the first thereinto, as described, this last band securing the fabric of the former bands together across the groove or channel into which the former has been depressed and prevent the fold thus laid from unfolding.

A^2 A^2 represent shoulders or margins of a channel in the face of the wheel which is the full width of the tire-cover to be formed thereon and which serve as gages at which the wider of the two pieces of fabric will be folded over the edge of the other, which is cut only of the width of the space between these gage-shoulders.

C is a wheel or roller having a dull knife-edged periphery adapting it to force the fabric into the grooves when it is pressed against the outer surface of the fabric as the latter lies over the grooves while the wheel A revolves. The wheel C may be mounted in a handle to be held by the operator while pressing the wheel into the grooves, as in Fig. 3, or there may be two such wheels mounted on a common hub C′ or roller provided with two beads, amounting to the same thing, carried in bearings D D, movable with respect to the forming-wheel A, so that both wheels may be simultaneously pressed up against the wheel A as the latter revolves and the fabric stretched into both grooves at once. There is some advantage in thus working upon both grooves at the same time, because thereby the fabric is drawn both ways from the middle at once and is not stretched out of position, as it might be if one line only were operated at a time. The tire-cover thus formed on the wheel may be without the tread-rubber, such tread-rubber being afterward cemented to it; but the device affords a convenient means of completing the tire-cover with the tread secured to it, which may be done by first wrapping the tread-rubber, which has been molded in a strip of proper cross-section, about the wheel A in the space between the two grooves A′ A′, which corresponds to the space to be occupied by the tread in the completed tire-cover. The fabric will then be applied outside the tread-rubber, as already described, and when the process of shaping on the wheel by stretching the fabric into the grooves is completed and the cover is ready for vulcanizing such vulcanizing process will unite the tread-rubber to the cover in the most perfect manner.

When it is desired to make heavy beads or lips for any purpose, the grooves in the wheel will be shaped accordingly, and any desired filling in the shape of a cord or strip of any material will be wound in the grooves into which the fabric has been depressed, thus further stretching the fabric into the groove if it has not been fully forced thereinto and occupying the space remaining.

If in any case it is desired to make a tire adapted to be turned and used either side out, a filling-strip wider than the depth of the groove or than the depth to which the fabric is forced into the groove will be wound thereinto and will project in a ridge or bead from the face of the wheel and another layer or layers to any desired number of fabric being then wound upon the wheel, another wheel E, having corresponding grooves, being moved up against the first and the two wheels revolved face to face with only the material which has been wound upon the first wheel between them, the last-wound fabric will be stretched over the protruding ribs of the filling and against the foremost fabric bands, to which it will adhere. If the tread-rubber is to be also applied to the cover before vulcanizing, it may be applied at the same time outside of the fabric, and the vulcanizing process being afterward completed the tire-cover will be alike on both sides and have properly-projecting beads adapting it to be used either side out and therefore adapting it to be reversed after being worn upon one side.

I claim—

1. A tire or tire-cover in the form of an endless seamless band as distinguished from a band whose ends are joined after the band is made, or a tubular annulus, such band being composed of fabric embedded in vulcanized rubber, and having beads or flanges parallel to the lateral edges, which, as to the vulcanized rubber are integral with the endless band, and which contain integral tucks of the fabric folded up into the beads or flanges embedded in the integral rubber substance thereof.

2. A tire or tire-cover in the form of an endless band composed of fabric embedded in vulcanized rubber and having beads or flanges parallel to the lateral edges, which as to the vulcanized rubber are integral with the end less band, and which contain integral tucks of the fabric folded up into beads or flanges into the integral rubber substance thereof; in combination with a layer of fabric which is also embedded in the integral rubber substance and extends across the base or back of the tucks.

3. A tire or tire-cover in the form of an endless seamless band as distinguished from one whose ends are joined after the band is made or from a tubular annulus, such band being composed of oppositely-placed layers of bias fabric whose threads are embedded in vulcanized rubber and having beads or flanges parallel to the lateral edges, which, as to vulcanized rubber, are integral with the endless band and which contain integral tucks of the bias fabric folded up into the beads or flanges in the integral rubber substance thereof.

4. A tire or tire-cover in the form of an endless seamless band as distinguished from one whose ends are joined after the band is made, or from a tubular annulus, such band being composed of rubber-saturated bias fabric having beads or flanges parallel to the lateral edges, which beads or flanges as to the rubber are vulcanized and integral with the endless band and which contain integral tucks of fabric constituting the exterior surface of the beads or flanges having its threads embedded with the vulcanized rubber as distinguished from being inclosed bodily in such rubber.

THOS. B. JEFFERY.

Witnesses:

JEAN ELLIOTT,

E. T. WRAY.

Defendant's Exhibit N—Bayne & Subers Patent.

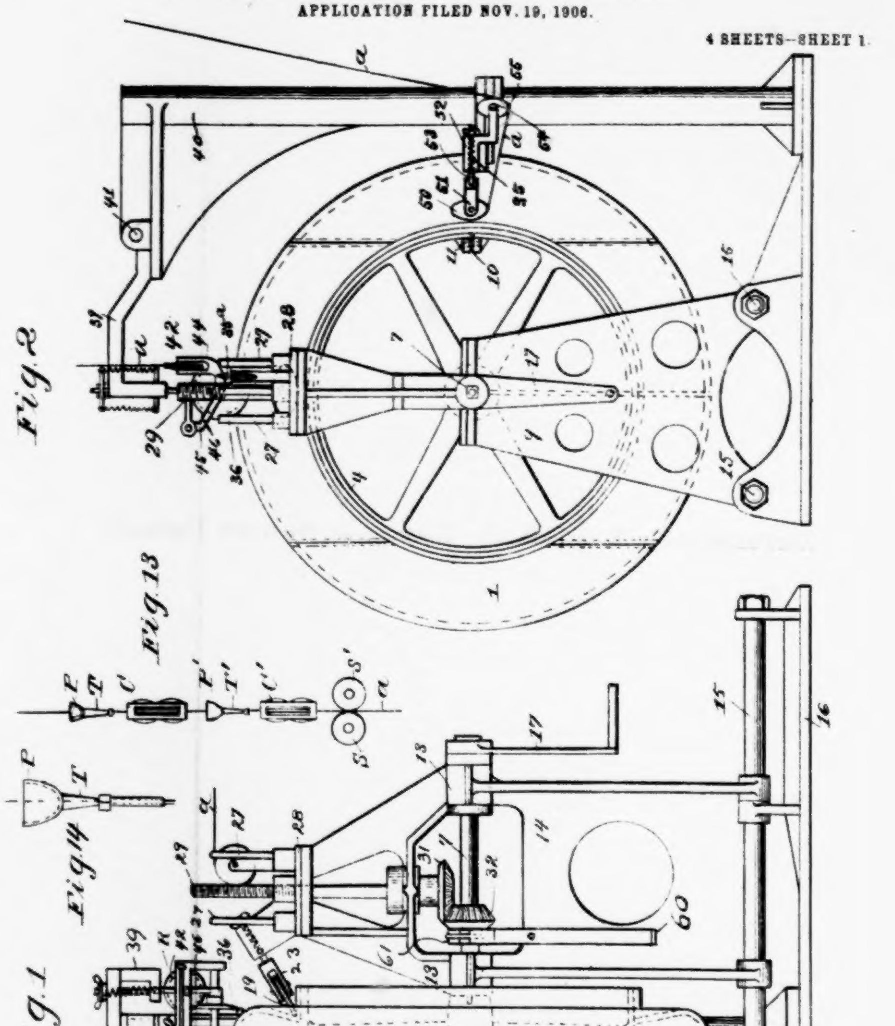
No. 847,041. PATENTED MAR. 12, 1907

E. D. C. BAYNE & L. A. SUBERS.

AUTOMOBILE TIRE WINDING MACHINE.

APPLICATION FILED NOV. 19, 1906.

4 SHEETS—SHEET 1.



Witnesses,
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O. M. Walworth

Inventors
Eugene D. C. Bayne
by Lawrence A. Subers
Wm. M. Monroe Attorney

294

No 847,041. PATENTED MAR. 12, 1907.

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AUTOMOBILE TIRE WINDING MACHINE.

APPLICATION FILED NOV. 19, 1906.

4 SHEETS—SHEET 2.

Fig. 6

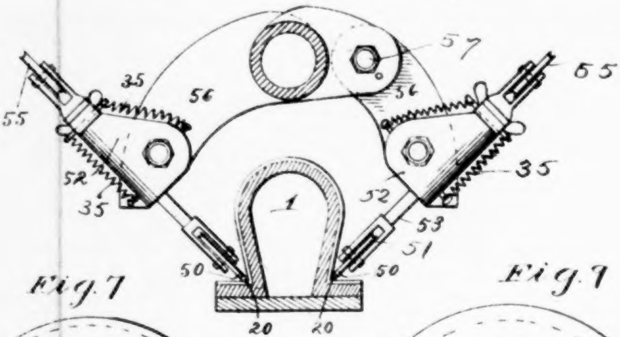


Fig. 7

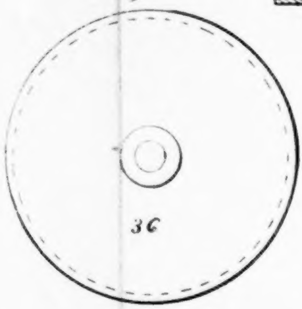


Fig. 9

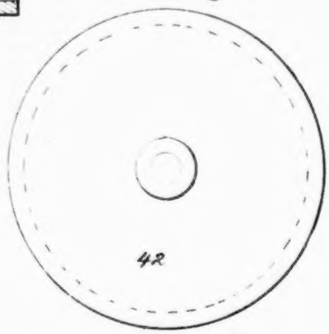


Fig. 8

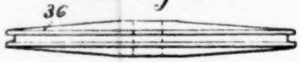
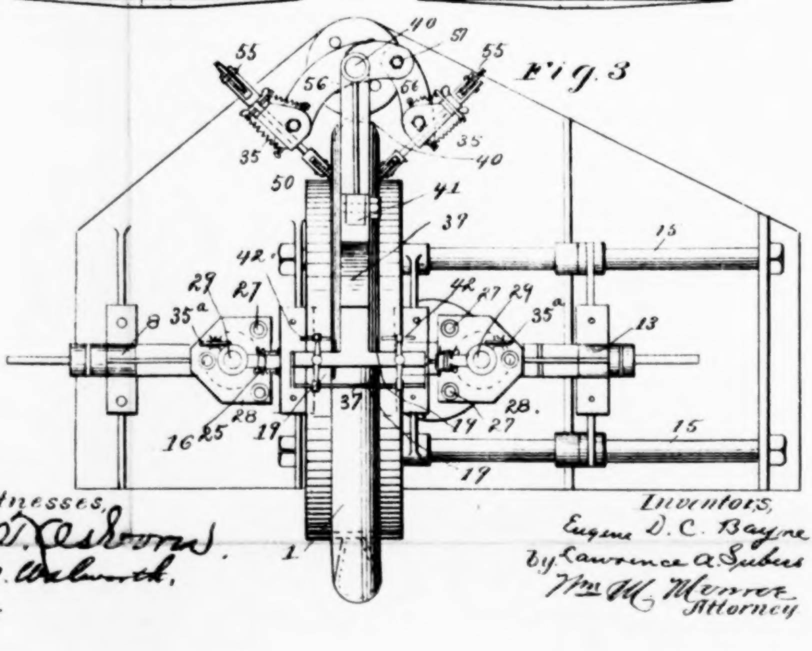


Fig. 10

Fig. 3



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No. 847,041. PATENTED MAR. 12, 1907.

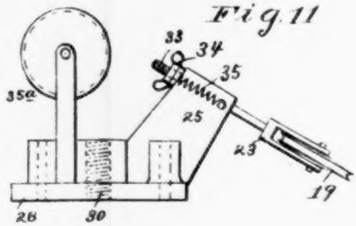
E. D. C. BAYNE & L. A. SUBERS.

AUTOMOBILE TIRE WINDING MACHINE.

APPLICATION FILED NOV. 19, 1906.

4 SHEETS—SHEET 3.

Fig. 11



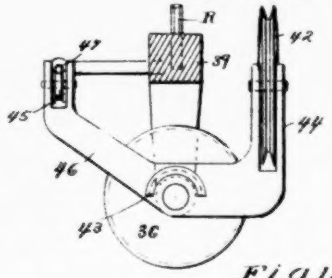
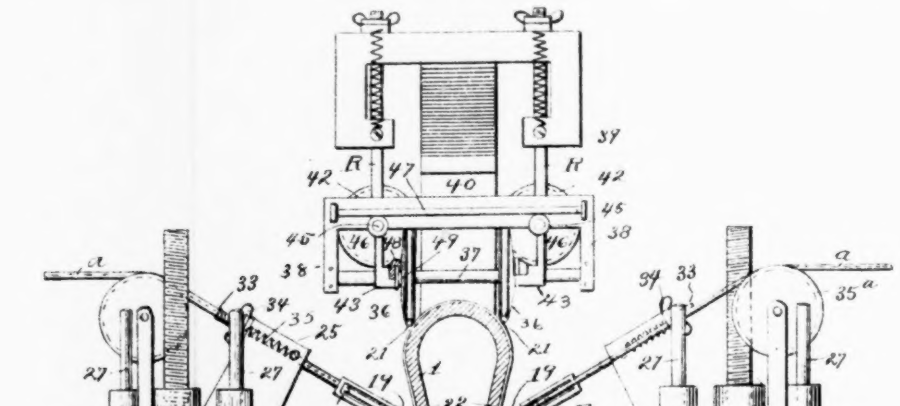


Fig 12

Fig. 4



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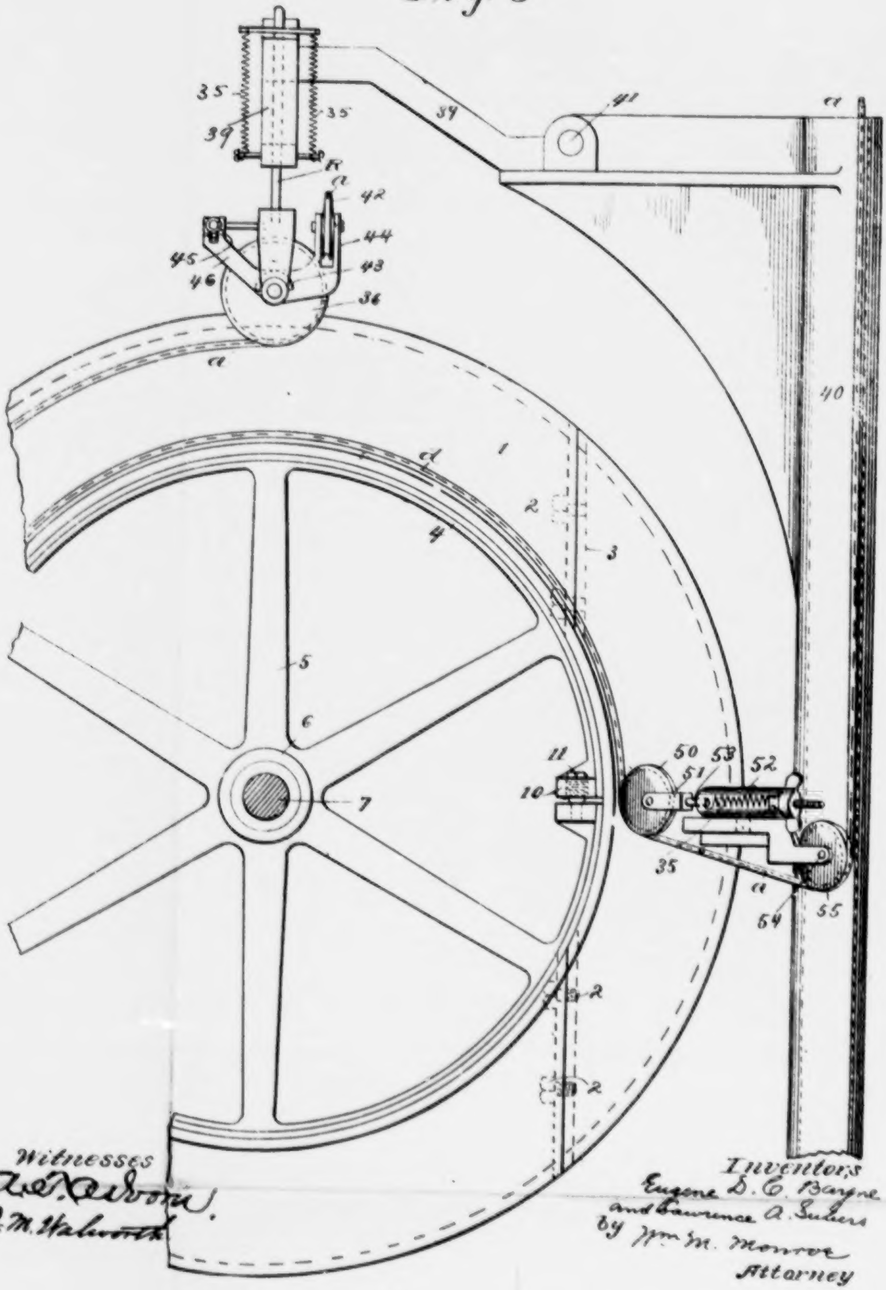
4 SHEETS—SHEET 4.

Fig. 5



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UNITED STATES PATENT OFFICE.

EUGENE D. C. BAYNE AND LAWRENCE A. SUBERS, OF CLEVELAND, OHIO.

AUTOMOBILE-TIRE-WINDING MACHINE.

No. 847,041. **Specification of Letters Patent.** **Patented March 12, 1907.**

Application filed November 19, 1906. Serial No. 344,094.

To all whom it may concern:

Be it known that we, EUGENE D. C. BAYNE and LAWRENCE A. SUBERS, citizens of the United States, and residents of Cleveland, county of Cuyahoga, State of Ohio, have invented certain new and useful Improvements in Automobile-Tire-Winding Machines, of which we hereby declare the following to be a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to improvements in machinery for winding pneumatic-tire cases and inner tubes, and is designed to overcome the inherent difficulties in laying the thread (which enters into the composition of the tire) circumferentially therein, and thereby provide a form of tire-casing and tube therefor which will be capable of resisting all circumferential and tangential strains and have an accordingly increased efficiency and durability in use.

The invention comprises a rotatable, detachable, collapsible, and highly-polished metallic tire-frame having a cross-section similar to that of the tire and upon which the circumferentially-laid thread is wound; also instrumentalities for applying the thread closely to the wheel-surface as the tire-frame is rotated upon its axis, and automatically-operating mechanism for feeding the thread in closely-approximated rows upon the tire-frame surface, so that the several strands shall adhere together and form a uniform coating or layer thereon.

Furthermore, the machine is designed for use in winding the form of tire described in an accompanying application for a patent, in which a layer of transversely-laid thread is alternated with a layer of circumferentially-wound thread, and each thread is enveloped in a tube or solid coating of insulating and preferably vulcanizable material, which at the time of winding has an adhesive surface, so that as the threads are successively wound upon the surface of the tire-frame they will adhere together and the completed fabric or tire will form an integral or unitary structure, and when vulcanized a perfect vendible tire of heretofore unattainable strength and resistance to circumferential and transverse stresses is thus obtained.

The invention also comprises the detachable, collapsible, and highly-polished metallic tire-frame, the various instrumentalities for guiding and feeding the thread, and means for automatically adjusting the positions of the thread guiding and applying instrumentalities, and the various means for preparing and feeding the prepared thread to the machine and the combination and arrangement of the various parts and construction of details, as hereinafter described, shown in the accompanying drawings, and specifically pointed out in the claims.

In the accompanying drawings, Figure 1 is a front elevation of the device, showing the rotatable tire-frame, its support, and the positions of the various thread-guiding and thread-applying devices and the means for preparing the thread. Fig. 2 is a side elevation thereof. Fig. 3 is a plan view thereof. Fig. 4 is an enlarged sectional view showing the upper part of Fig. 1. Fig. 5 is an enlarged view of the upper part of Fig. 2. Fig. 6 is a transverse section of tire-frame on center line, showing the thread-laying rollers or director-wheels which apply the thread to the laterally-extending flange of the tire-frame, which corresponds to the clencher portion of the tire. Figs. 7 and 8 are detail views in plan and elevation of one of the director-wheels, by means of which it is applied to its exact position upon the tire-frame. Figs. 9 and 10 are similar views of one of the thread-guiding wheels. Fig. 11 is an enlarged detail of one of the director-wheel holders, by means of which the sides of the tire are wound. Fig. 12 is a similar view of the balanced holder for the thread surface of the tire. Figs. 13 and 14 are detail views of the receptacles, draw-tubes, and air-passages through which the cord passes to the machine in its insulated form.

In the figures, 1 is a detachable, collapsible, and highly-polished metallic tire-frame upon which the threads forming the tire casing or tube are wound. This tire-frame is divisible into four sectional parts attached together by means of the bolts 2, passing through flanges 3, so that the completed tire casing or tube can readily be removed. This sectional tire-frame is mounted upon the periphery of the wheel-rim 4, which is supported by means of arms 5 and hub 6 upon a driving-shaft 7, mounted in bearings 8 on a suitable frame 9. The rim is made expansible to securely clamp the tire-frame thereon by means of the slotted opening 10 therethrough and a connecting or expanding bolt or bolts

11, by means of which the edges of the slot can be forced apart, and thus employ frictional contact under pressure to retain the tire-frame in position.

In order to make the removal of the tire-frame convenient, the shaft upon which the wheel-hub 6 is mounted is divided within the hub or adjacent thereto, as at 12, and the outer bearings 13 and frame 14 are slidably mounted upon guides, such as the rods 15, upon the common bed-plate 16, so that the outer bearings and outer portion of the shaft can be moved to permit of the removal of the tire casing or tube.

Means for rotating the tire-frame are shown, as cranks 17, upon each end of the shaft; but we do not limit ourselves to the identical forms of construction of this or other portions of the machine, since other equivalent means can be employed to obtain the desired results and lie within the spirit of the invention.

The two portions of the shaft rotate in common, and a tongue upon one portion is shown entering a groove in the other portion with this object in view.

Upon each side of the vertical center of the tire-frame are shown the director-wheels 19 19, over which the prepared insulated threads A, having a perfectly cylindrical and compressed surface, are designed to run, and which apply the threads directly to the surface of the tire-frame upon the sides thereof, commencing at the inner edge or angle 20 and build the thread A in a constantly-increasing spiral wind with the incasing insulation of each row of threads in contact until a position is reached at 21 at approximately an angle of thirty degrees to the axis of the tire-frame. These threads being incased in adhesive material immediately adhere together and to the transversely-laid layer 22 of similar thread below and retain their position without difficulty, and being of perfect shape and having a carefully-adjusted regular upward movement fit immediately into their places without possible distortion or danger of overlapping of the separate strands.

The upward movement of the winding or director wheels is automatically accomplished, and this movement and the means for obtaining such slight lateral movements under control as may be necessitated by the flaring or out of vertical shape of the tire-frame sides may be described as follows: The director-wheels are pivotally mounted within the forks 23, which pass through squared openings in the supports 25. The fork-stems are also angular, so as not to rotate in these openings. These supports are vertically movable upon guide-rods 27 27, fixed in the platforms 28 28, which are mounted upon the frame portions 9 and 14.

The supports for the director-forks and director-wheels are slowly raised to correspond to the diametrical increase in the size of the spiral winds by means of the right and left screw-threaded vertical shafts 29 29, which pass through corresponding nuts 30 in the supports, and these shafts are rotated in conjunction with the shaft by means of the connecting bevel-gears 31 and 32 and the movements are accurately proportioned and the pitch of the screw so regulated as to raise the platforms 28 28 and the director-wheels 19 19 carrying the thread upon the periphery of the tire-frame exactly one diameter of the thread at each revolution of the tire-frame.

The forks can be set to limit their inward travel by means of screw-threads 33 upon their outer ends and nuts 34 engaging their supports. Springs 35, connecting the forks and supports, force the director-wheels into constant contact with the tire-frame, so that the thread is directly applied thereon and cannot get out of position and also provide sufficient elasticity to permit of lateral movement to the required degree. Guide-wheels 35ᵃ serve to direct the thread to the director-wheels.

Clutch levers and rings 60 and 61 engage the bevel-gears 32 on the shaft 7 and throw the gears to stop the action of the right and left hand screws 29 29 as soon as the threads have been wound sufficiently high on the tire-frame to permit the winding of the crown portion thereof, and the director-wheels meet closely and the thread is moved from one to the other by hand.

As soon as the sides of the tire-frame are wound full up to the angle suggested other director-wheels 36, arranged to engage each side of the center of the crown on the tread-surface of the tire-frame, are employed to continue the winding of the threads to the diametrical central plane of the tire-frame. These wheels are mounted upon a horizontal rod 37, upon which they are free to move laterally, and this rod is mounted in a wide fork 38, which is adjustably supported for vertical movement in the head 39 by means of spring-pressed rods R. The head is attached to the standard 40 by means of a pivot 41, which enables the head and attached fork and director-wheels to be lifted while removing the tire casing or tube.

It will be seen that as one thread is laid after the other the director-wheels 36 will readily move toward each other until they completely fill the tread on the crown portion of the tire-frame—that is, the grooves in the director-wheels 36 follow the insulated threads as they are laid, and hence the wheels move toward each other as the rows of thread increase in number until the flat sides of the two director-wheels engage at the center of the crown.

Guide-wheels 42 42 are employed to guide the threads to the director-wheels, and since they must move with the director-wheels

each guide-wheel is mounted in an arm 44, attached to a central hub 43, which is in turn provided with a semicircular flange and groove 48, which is engaged by an annular flange 49 upon the hub of the director-wheel, so that the director-wheel will move the guide-wheel arm as it travels. To prevent the guide-wheel from tipping, a second arm 46 is provided with a roller 45, which runs upon a horizontal rod 47, mounted upon the fork 38.

The highest path of each side-winding director-wheel and the lowest path of each crown director-wheel come so closely together that the thread will almost run from one to the other. However, the thread is placed in position in the proper guide when the exact position of transfer is attained and the machine is not necessarily stopped to permit this transfer if run slowly.

The devices for winding the thread upon the lateral extension E of the tire-frame are seen to be operated simultaneously on each side thereof and comprise director-wheels 50, pivoted in spring-controlled forks 51, which move longitudinally in supports 52 and the stems 53 are squared to prevent them from turning. Upon these supports are also rigid forks 54, in which are pivoted the guide-wheels 55, by means of which the threads are brought to the director-wheels. These supports 52 are pivoted for lateral swinging movement upon the arms 56, which are attached to the same standard which supports the director-wheels 36 36 above. One of these arms is hinged at 57 so that it can be turned away from the tire-frame when the tire casing or tube is to be removed.

The director-wheels first place the thread in the innermost angle at 20, and thence the pressure of the adjacent thread will cause the directors to lay the thread smoothly in outwardly-widening circles until the edge is reached.

Since the groove in each director-wheel 50 will follow the insulated thread as it is laid and as the rows of thread extend farther from the center of the frame, the director-wheels follow the widening circles and the springs maintain an elastic pressure of the director-wheels upon the threads. The springs 35 readily permit of this action.

An essential portion of the device is found in the instrumentalities for coating the thread with the tubular insulation, since the thread thus coated is too sticky to be wound upon spools or spindles and must come directly from the bath and formers to the tire-frame. This device is specifically represented in Figs. 13 and 14 and comprises a series of receptacles, such as P and P′, filled with a solution of insulating material, such as rubber, through which the thread passes. Each receptacle is provided with a vertically-extending tube T, preferably of funnel shape, through which the thread passes. The tubes are graduated in size, and after the thread has received its first coating in the upper tube it passes through a box or conduit C, through which a drying-current of air passes, and when thoroughly dried the thread passes through the lower receptacle P′ and through second tube T′ of slightly larger diameter than the first tubes T, which increase the thickness of the coating materially. A second drying-current of air is passed through the conduit C, then dries the coating thoroughly, although the sticky surface is still retained. The tubular coating upon the thread is then molded and compressed into a perfect cylindrical form while still plastic and by means of rollers S and S′, which are designed to draw the thread centrally through the tubes at a speed equaling the speed of the machine, so that the thread will not be under any undue tension when applied to the tire-frame. In this manner a perfect tire-casing or tube can be wound with circumferential and transverse layers of thread, which are not at any time in direct contact, and hence have no frictional bearing upon each other. The layers of transverse thread can be introduced at any time most convenient in the course of the winding. The transverse layers of thread can be introduced by hand upon the tire-frame in the path of the winders, so that one continuous action will wind the complete wheel.

We believe ourselves to be the first to wind a pneumatic tire-case and inner tube with threads in a circumferential manner by means of a collapsible circular frame and automatically-operating mechanism adapted to apply the thread thereto and also to apply a thread having a tenacious surface thereto or to a tenacious coating thereon under elastic pressure. It will be observed that while the springs upon the director-guides serve to permit of lateral and vertical movement under control of the threads they also provide a continuous pressure thereto, which forces the threads into their exact position relative to each other and assists in producing a regular and even wind, as well as compelling the threads into a more intimate contact, so that their contacting surfaces will adhere closely together.

Having described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a machine for circumferentially winding insulated thread to form a tire-casing or tube, a circular frame separable into component portions, a rotatable support to which the tire-frame is detachably secured at its inner edge, a shaft on which said rotatable support is secured, and means for rotating the shaft, substantially as described.

2. In a machine for the purpose described, a rotatable tire-frame, said tire-frame being

divisible in sections, a rotatable support upon which said tire-frame is mounted, said tire-frame being detachable from said support, a shaft having a separable portion upon which said support and tire-frame are mounted, and bearings for each portion of said shaft, the bearings for said separable portion of said shaft being movable toward and from said tire-frame and support, substantially as described.

3. In a machine for the purpose described, an annular rotatable tire-frame formed in separable portions, a rotatable support therefor to which the tire-frame is detachably secured at its inner edge, a shaft on which said tire-frame and support are mounted, means for rotating said shaft and instrumentalities for applying a thread insulated with adhesive material to all parts of the surface of said tire-frame, as said tire-frame rotates whereby said insulated thread is wound circumferentially thereon, substantially as described.

4. The combination with a rotatable collapsible tire-frame and a pivotal support therefor, of means for rotating said tire-frame and instrumentalities for applying threads insulated with an adhesive substance simultaneously to the crown and side surfaces of said tire-frame as said tire-frame rotates, whereby said insulated threads are circumferentially wound thereon, substantially as described.

5. The combination with a rotatable tire-frame having sides and tread and lateral surfaces and a pivot-support therefor, of means for rotating said tire-frame, instrumentalities for applying thread insulated with adhesive material directly to the sides of said tire-frame, instrumentalities for applying similar insulated thread to the tread portion thereof, and instrumentalities for applying thread similarly treated to the lateral surfaces thereof, whereby a unitary surface is produced, substantially as described.

6. In a machine for the purpose described, the combination with a separable rotatable tire-frame, of a rotatable wheel having an expansible rim upon which said tire-frame is mounted, a supporting-shaft therefor interlocking extremities for said shaft, fixed bearings for one portion of said shaft and movable bearings for the other portion of said shaft and means for rotating said shaft and tire-frame and tire-frame support, substantially as described.

7. The combination with a rotatable tire-frame, having side, tread and lateral surfaces adapted to receive circumferentially-wound insulated threads, and a pivotal support therefor of means for rotating said tire-frame, director-wheels positioned and arranged upon each side of said tire-frame, by means of which insulated thread is applied to the aforesaid surfaces of said tire-frame, and instrumentalities for obtaining lateral and vertical movements for the director-wheels, substantially as described.

8. The combination with a rotatable tire-frame on which circumferentially-laid insulated threads can be wound and means for rotating the same, of director-wheels over which the insulated threads are applied to the tire-frame, supports for said wheels, means for supplying said wheels with elastic pressure and guide-wheels on said supports adapted to lead the insulated threads to said director-wheels, substantially as described.

9. In combination with a rotatable tire-frame having tread and side and lateral surfaces, and a pivotal support therefor of means for rotating the tire-frame, grooved spring-pressed directors adapted to apply the insulated thread to the aforesaid surfaces, supports for said directors, and means for giving a radial movement to the directors which apply the insulated thread to the sides of the tire-frame, said movement controlled by the said means for rotating said tire-frame, substantially as described.

10. In combination in a machine for the purpose set forth, a rotatable tire-frame having a crown, sides and lateral extensions, a shaft and rimmed wheel on which the tire-frame is mounted, spring-pressed director-wheels in engagement respectively with the crown, sides and lateral extensions of said tire-frame, and arranged to apply an insulated thread directly thereto in a circumferential wind and automatically-operating mechanism for radially moving the side-winding director-wheels to correspond to the increasing diameter of the wind, substantially as described.

11. In combination in a machine for the purpose set forth, a rotatable tire-frame having a crown and side portions, an operating-shaft therefor, director-wheels and supports therefor adjacent to said tire-frame and on both sides thereof, adapted and arranged to engage the respective surfaces of crown and side portions, the supports for the director-wheels for the side portions having screw-threaded openings, screw-threaded shafts passing through said screw-threaded openings in said supports, and a geared connection between said screw-threaded shafts and the said operating-shaft, substantially as described.

12. In combination, in a machine for winding insulated threads circumferentially to form a tire-casing or tube, a rotatable and separable tire-frame having crown, side and laterally-extending portions, a rimmed wheel on which the tire-frame is mounted, a divided shaft therefor, bearings for said wheel, a bed-plate upon which said bearings are mounted, one set of said bearings being movable thereon, a pair of director-wheels for said thread adapted to engage the crown portion of said

tire-frame and to move together as said cord is laid, a pair of director-wheels adapted to engage the side portions of said tire-frame and move diametrically outward as the thread is wound, a common support for the said crown-engaging wheels, said support mounted on said bed-plate, supports for said side-engaging wheels, said supports mounted in guides for radial movement relatively to said tire-frame, and having screw-threaded openings therein, and screw-threaded shafts passing through said openings and geared connections for said shafts and divided shafts, substantially as described.

13. A support for a pair of director-guides for the purpose set forth, consisting of a standard, an arm pivoted thereon, vertical rods spring-pressed and arranged for vertical movement in said arm, a fork to which the lower ends of said rods are secured, a horizontal rod in said fork, upon which said director-wheels are loosely mounted, a semicircular hub for each wheel, in which said wheel rotates said hub having arms a guide-wheel in one of said arms, and a roller in the other, and a horizontal rod on said fork, on which said roller runs, substantially as described.

14. In combination with director-wheels, adapted to wind the crown-surface of a tire-case or tube, a horizontal rod on which said wheels are mounted, a support for said rod, an arm to which said support is adjustably secured for vertical movement, a guide-wheel for each director-wheel, said guide-wheels being arranged to move in unison with said director-wheels, substantially as described.

15. The combination with a collapsible and rotatable tire-frame, formed in detachable portions, having a coating of tenacious fabric thereon, of automatically-acting instrumentalities for applying a circumferential wind of thread thereon under elastic pressure.

16. The combination with a collapsible and rotatable tire-frame, of a rotating device for applying a circumferential wind of thread having a tenacious surface thereupon under elastic pressure.

17. The combination with a collapsible annular tire-frame, formed in detachable portions, of an expansible wheel-rim upon which said frame is detachably secured, and means for rotating said wheel, substantially as described.

In testimony whereof we herewith set our hands this 17th day of November, 1906.

EUGENE D. C. BAYNE.
LAWRENCE A. SUBERS.

Witnesses:
A. T. Osborn,
C. M. Wolworth

Defendant's Exhibit O, Mathern German Patent.

Translation.

GERMAN PATENT No. 206,197.

Class 63*c*. Group 10.

ALPHONSE MATHERN, BERLIN.

Machine for the Mechanical Production of Shoes for Pneumatic Tires.

Patented in the German Empire from December 20, 1906. Published January 26, 1909.

The subject of the invention is a machine for the mechanical manufacture of shoes for pneumatic tires. Such machines in which the fabric to be wound around the tire core unwinds in the shape of a strip from a drum and is stretched in its middle part by curved rollers are not new. The novelty consists in the fact that the edges of the fabric are laid in uniform folds by means of two bevel wheels and thereby shortened. The curved part of the fabric is then pressed against the core ring by radially reciprocating rolls. The edges of the fabric, on the other hand, are pressed against the core ring by the step-wise arranged rolls and a sector moving back and forth in the direction of the periphery, whereby the folds are removed.

In the accompanying drawing a form of construction of the machine and the different tools required are shown, fig. 1 being a side view, fig. 2 a plan, and fig. 3 a section on line A-B of fig. 1. Fig. 4 is a section on line C-D of fig. 1. Figs. 5, 6 and 7 show in elevation, plan and transverse section respectively the tool used to put on the beads. Fig. 8, finally, is a transverse section of a tire shoe made by means of the machine.

The machine is mounted on a cast-iron frame 1 fitted with two lateral uprights 2 designed to carry the guides

and bearings for the movable parts. The cone pulley 3 with gears 4 secured thereto drives the wheel 5, which by means of the gear 6 transmits the movement to a wheel 7 keyed on the shaft 11. Said shaft 11 by means of gear 8 drives the wheel 9 mounted on the shaft 12. To the shaft 12 the shaping core 10 is secured, which rotates with the shaft 12 at a speed sufficient to wind the canvas on the core and fit on the rim beads and tread.

The cone pulley 3 is loosely mounted on its shaft, but may instead be connected with the shaft by a coupling. Gears 5 and 6 are arranged on an eccentrically mounted shaft 13 and are capable of being displaced laterally by means of the adjusting device 34. When this has been done and the cone pulley has been coupled with its shaft the gear 8 mounted on said shaft directly drives the shaft 12 by means of the wheel 9, and thus sufficient speed of the shaping core is insured to remove the folds from the canvas on the core, to trim said canvas, to rub off the finished skeleton, etc.

The shaft 12 is fitted with a claw coupling 15 by means of which it may be rendered independent of the wheel 9. The shaft thus rotates freely, and the core ring may be turned by hand in any direction, either for the purpose of inspecting the work or of cleaning the canvas. On the shaft 12 a sliding member 16 is mounted in which moves vertically a slide 17 forming the tool holder and designed to receive the tools required for the different operations.

The canvas is wound on a wooden drum 18 which is fitted with adjustable lateral disks 19 for the different widths of the canvas which may be used. Said wooden drum is mounted on a shaft 20 which is square at this point but round over the remainder of its length. Said shaft 20 carries a drum 21 on to which wind steel bands which are tightened at one end by the screw 22 and the hand wheel 23 and held in position, at the other end, by a tension spring 24.

The shaft 20 is capable of being pushed forward and backward transversely to its axis according to the diameter of the tire to be made. To that end said shaft is mounted in two sliding bearings 25 provided on the lateral uprights 2.

The different pieces of canvas are put on the core 10 in the following manner:

The shaft 20 rotatable in the two bearings 25 carries, as previously stated, the canvas drum 18. As the canvas unwinds from the latter it is brought between two spherical or oval friction rollers 26, which are so arranged as to exert a rotary action on the middle part of the canvas whereby the formation of puckers at this point is rendered difficult. To the same support are fitted on each side two toothed bevel wheels 36, the object of which is merely to cause uniform puckering at the edges of canvas whereby a slight drawing back of the canvas at all points is insured from the outset. From there on the canvas is wound on the core 10 then coated with a caoutchouc solution to cause it to adhere firmly to the core and follow the rotary movement of the latter.

The spool 18 is held in its rotary movement by a brake band which acts on the cast-iron drum 21. By rotation of the hand wheel 23 tension is exerted on the bands 27 of the drum 21. The end of said bands is held in position by a spring 24, the tension of which is adjusted accordingly. It thereby becomes possible to stretch the canvas in a perfectly uniform manner more or less, according to the profiles to be produced by the machine.

On the rotating core 10 the canvas first reaches the rolls 30 which are so mounted as to reciprocate in the casing 28. The latter contains a cranked vertical shaft 33 which moves the slide 32 guided in the walls of the casing 28.

To said slide 32 are rotatably fastened two links 31

carrying at their ends rolls 30 which move back and forth over the core and thereby press the canvas just laid on the core against the straight or curved sides. When the core has made a complete rotation passing through said rolls 30, the casing 28 is pushed back on the guide 34. Then the speed of rotation of the machine is changed by bringing the cone pulley 3 into engagement with the shaft 11 and pushing aside the gears 5 and 6.

Thereupon the apparatus (sector) 29 shown in figs. 1 and 3 is brought into operation. It consists of two rows of pressure rolls 38 arranged stepwise, which have different peripheral velocities, and which by reason of their reciprocating movement admit of the progressive adhesion of the canvas without compelling the core 10 to make more than one rotation.

The various mechanisms may be driven in a manner different from that described above.

The rolls and disks may be fitted to any part of the core provided only that the movement of the same is effected in the manner indicated.

To fit the beads 40 (fig. 8) on the rim two pressure rolls 41 and 42 (figs. 5 to 7) are used. The pressure roll 41 seized the bead 40 from below, and the smaller roll 42 presses against it laterally. The periphery of the beading strip 40 is glued to the canvas by a slight pressure of the hand. To enable the beads to be placed very accurately in position there are provided in the sides of the roll-holder 43 guide holes 45 having the cross-sectional shape of the beads or inserts 40 to be put in position.

After the bead 40 has been introduced from the back into the guide hole 45, the two rolls 41 and 42 press against the core 10, and the latter upon its rotation carries the bead 40 along with it; the latter enters its guides, is thereby brought under the disks and accurately and quickly placed in position.

CLAIM

Machine for the mechanical manufacture of shoes for pneumatic tires in which the fabric to be wound around the tire core unwinds in the shape of a strip from a drum and the middle part of the same is stretched by curved rollers, characterized by the fact that the edges of the fabric are laid into uniform folds by means of two bevel wheels (36) and thereby shortened, whereupon the curved part of the fabric by means of radially reciprocating rolls (30), and the edges by means of the stepwise arranged rolls (38) of a sector (29) moving back and forth in the direction of the periphery, are pressed against the core ring (10).

Fig. 1. Fig. 4.

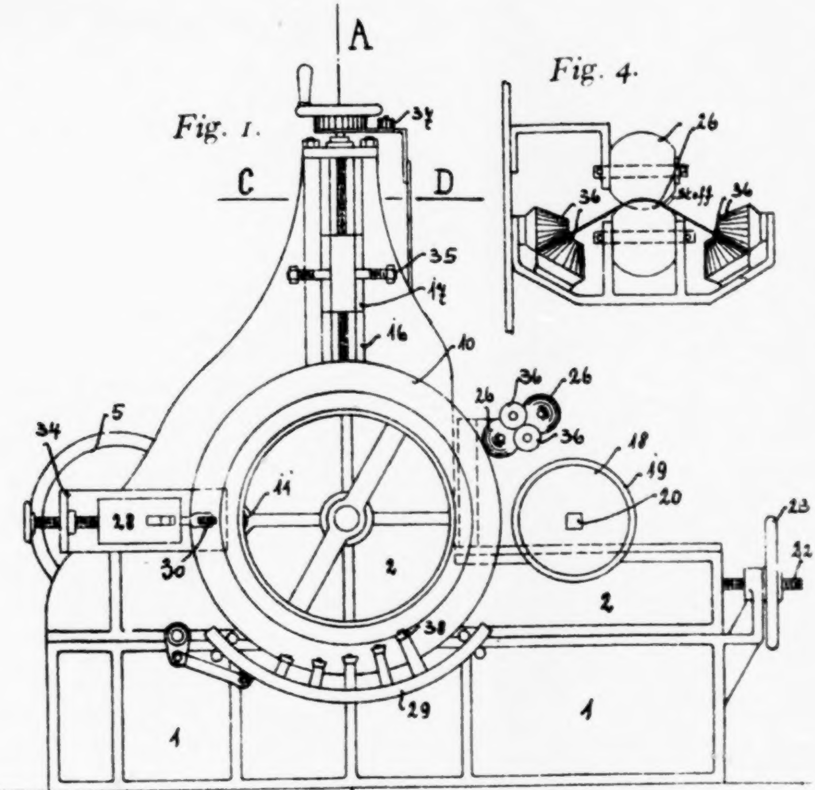

Fig. 2.

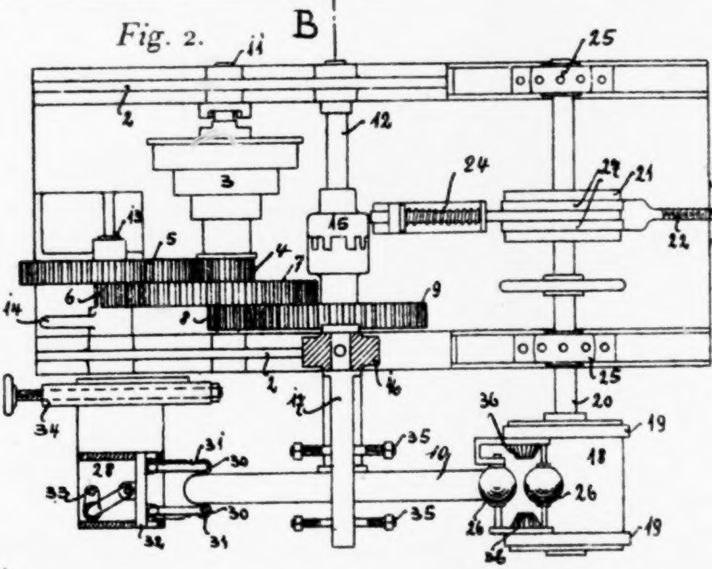

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Fig. 3.

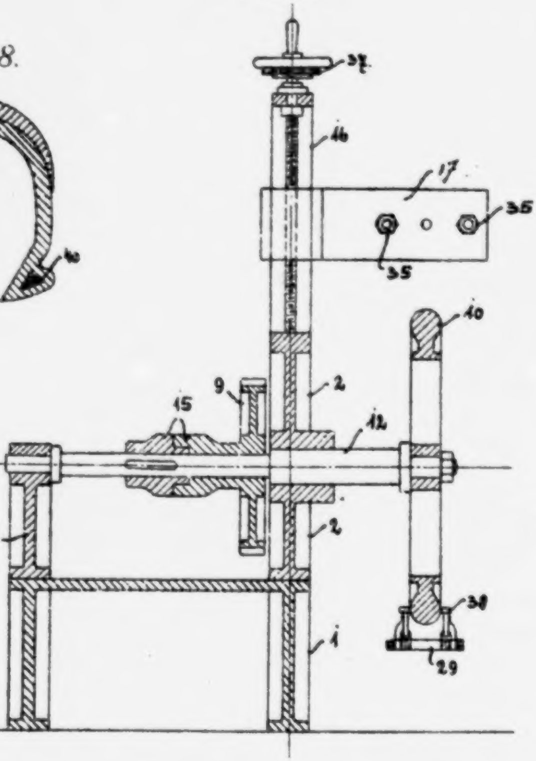


Fig. 8.

Fig. 5. Schnitt G-H.

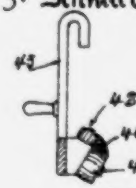


Fig. 6.

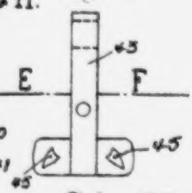


Fig. 7. Schnitt E-F

Zu der Patentschrift

№ 206197.

Defendant's Exhibit P, Hernandez Patent.

Translation.

FRENCH PATENT NO. 395,812.

X. Transportation on Roads.

1. Vehicles.

MARTIN HERNANDEZ, France.

Machine for the Manufacture of Pneumatic Tires. Date of application, January 7, 1908; of delivery, January 8, 1909; of publication, March 19, 1909.

(The delivery of this patent has been delayed in pursuance of art. 2, sec. 7, of the law of July 5, 1844, amended by the law of April 7, 1902.)

This invention which relates to a machine enabling pneumatic tires to be manufactured automatically is shown in the annexed drawing, in which:

Fig. 1 is an elevation of the entire machine;

Fig. 2 is a corresponding plan;

Fig. 3 is a front elevation of the frame on which the shaping core is placed;

Fig. 4 is a rear view of said frame showing the driving means;

Fig. 5 is a plan corresponding to figs. 3 and 4;

Figs. 6 and 7 finally show on a larger scale details of the shaping tools.

This machine consists of a frame a of iron or pig iron (figs. 3, 4 and 5) supporting a shaft a^1 which rotates in bearings and on which is suitably mounted an expandor consisting of a hub b fitted with three arms b^1 carrying lugs or stops b^2 on which is mounted a band or rim c through which pass three regulating screws c^1 designed to center the core d, which may be of different

diameters and which serves to give the required shape to the tires to be produced. The speed of rotation of said core, which is about a rotation per minute, is transmitted by a pulley a^2 (figs. 4 and 5) mounted on the end of a shaft a^1 by the side of a loose pulley.

The canvas x designed to produce the tire or tires on the core d is brought upon the latter by rollers mounted in a frame e. The roller e^1 on which the canvas is wound carries on its shaft, outside of the frame e, a grooved pulley e^2 with counterweight e^3 which enables the necessary tension to be insured. The canvas x coming from the roller e^1 passes over the intermediate roller e^4 which waves it as it passes over it and compels it to take up a larger part of the periphery of the roller e^5 over which it passes next, which insures a better shape of the canvas when the roller e^5 presents it to the core d.

At that moment when the canvas x reaches the core d it is subjected to the action of the different members designed to give it the shape of a pneumatic tire. To that end there is conveniently provided an iron or pig iron frame f carrying slides g and h on which travel carriages i and j. (The drawing shows only two of these elements of which there are in reality four identically alike.) The carriage i is capable of being displaced from the smallest to the largest diameter of the core. The carriage j is capable of being moved from the smallest to the largest cross-section of the core.

The carriage i is fitted with a circular tool holder formed of two plates, i^1, i^2 joined together by bolts. Between said two plates i^1, i^2 are secured six tubes i^3 (figs. 2 and 6) in which slide rods i^4 carrying at their ends rolls i^5. Said rods i^4 carry a screw i^6 sliding in a groove i^7 provided on the tube l^3 and serving to guide them, and are moreover subjected to the action of a spring i^8 which is located in the bottom of the tube i^3 and the object of which is to give them the necessary resiliency to cause

the canvas x, by means of the rolls i^5, to assume the form of the cord d and thus insure the shape of said canvas.

In fig. 6 one of the rods fitted with rolls is shown in the position before effecting the work of shaping, and the other in the position during such work.

The circular tool holder consisting of the plates i^1, i^2 is driven by a pulley i^9, which imparts to it a speed of about thirty revolutions a minute, which is sufficent to insure good results.

The tool holder carriages i are designed exclusively to shape the canvas from y to y^1 before the bead is put on, and from y to y^3 after the bead has been put on.

The carriage j (figs. 2 and 7) is fitted with a straight tool holder j^1, in which move four rods j^2 carrying respectively rolls j^3, j^4, j^5 and a cutter j^3. Said roll rods and knife are controlled by the action of two springs j^7, j^8 designed to give them resiliency and facilitate the shaping of the bead. Such resiliency may be reduced or increased at will by means of the set screw j^9. The cutter j^6 is designed to trim off the excess of canvas which may be outside of the base of the bead.

The object of the rolls j^3, j^4 and j^5 is to shape respectively the hook of the bead, the top of the bottom of the bead.

The straight tool holder carriages j^1 are designed to place the bead at proper height, to shape the canvas covering the same, and to trim the latter when they project over the face of the head.

The beads may be triangular, round, or of any other shape, and the rolls j^3, j^4, and j^5 may be given any suitable profile according to the shape to be obtained.

The automatic manufacturer of pneumatic tires refers only to the canvas, the rubber being put on by hand, and it is to be understood that the invention is not confined strictly to the machine illustrated in the annexed

drawing, which may undergo modifications without affecting the principle of the same.

F. P. 395,892.

RÉSUMÉ.

The object of the invention is:

A machine for the automatic manufacture of pneumatic tires of every size and for every kind of vehicles, characterized by a special device so operated as to shape the canvas on a core, while the rubber is put on by hand, to the end of forming such tires.

MARTIN HERNANDEZ,
By L. FRANCKEN, Attorney

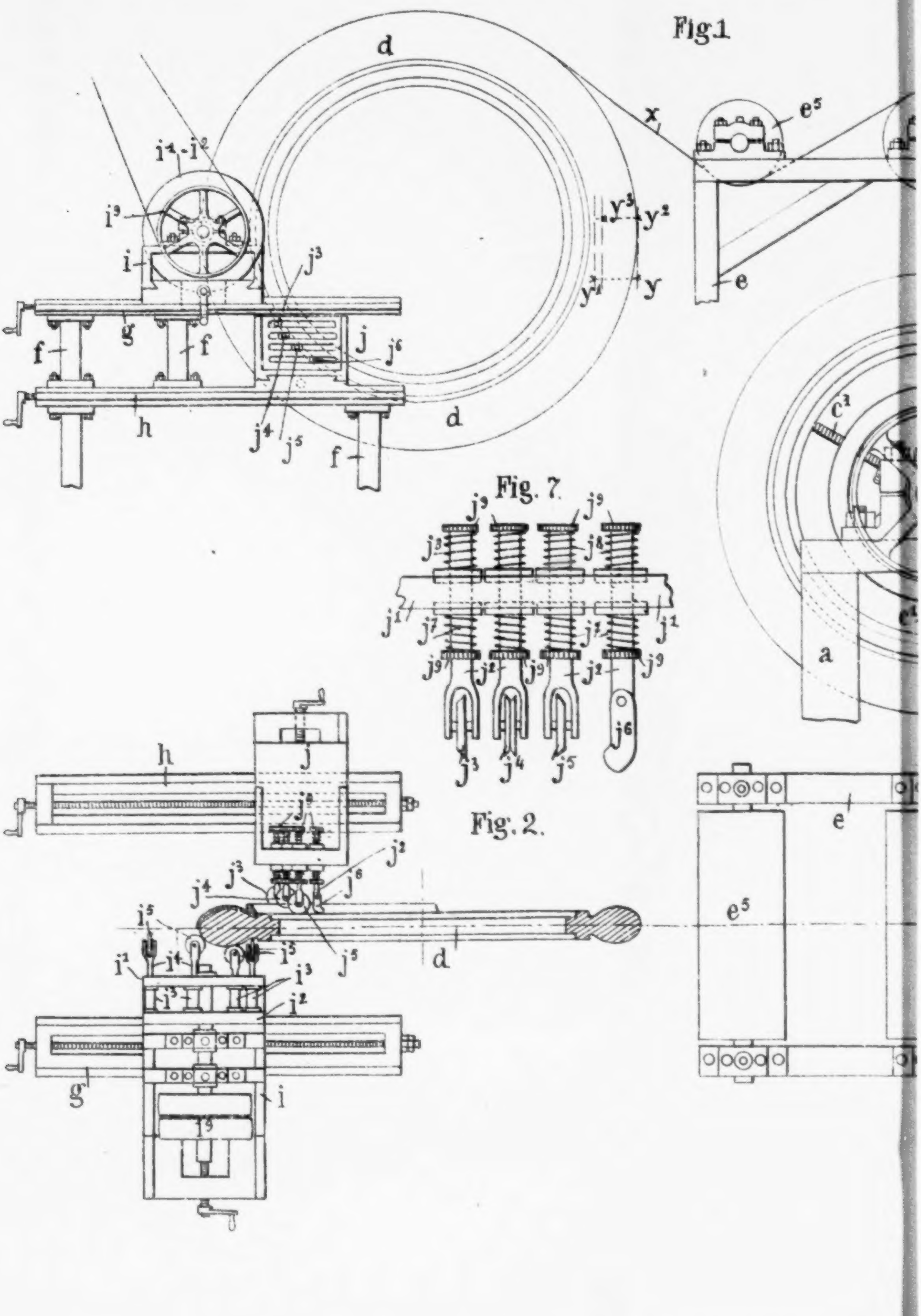


Fig. 1

Fig. 7

Fig. 2.

Pl. unique

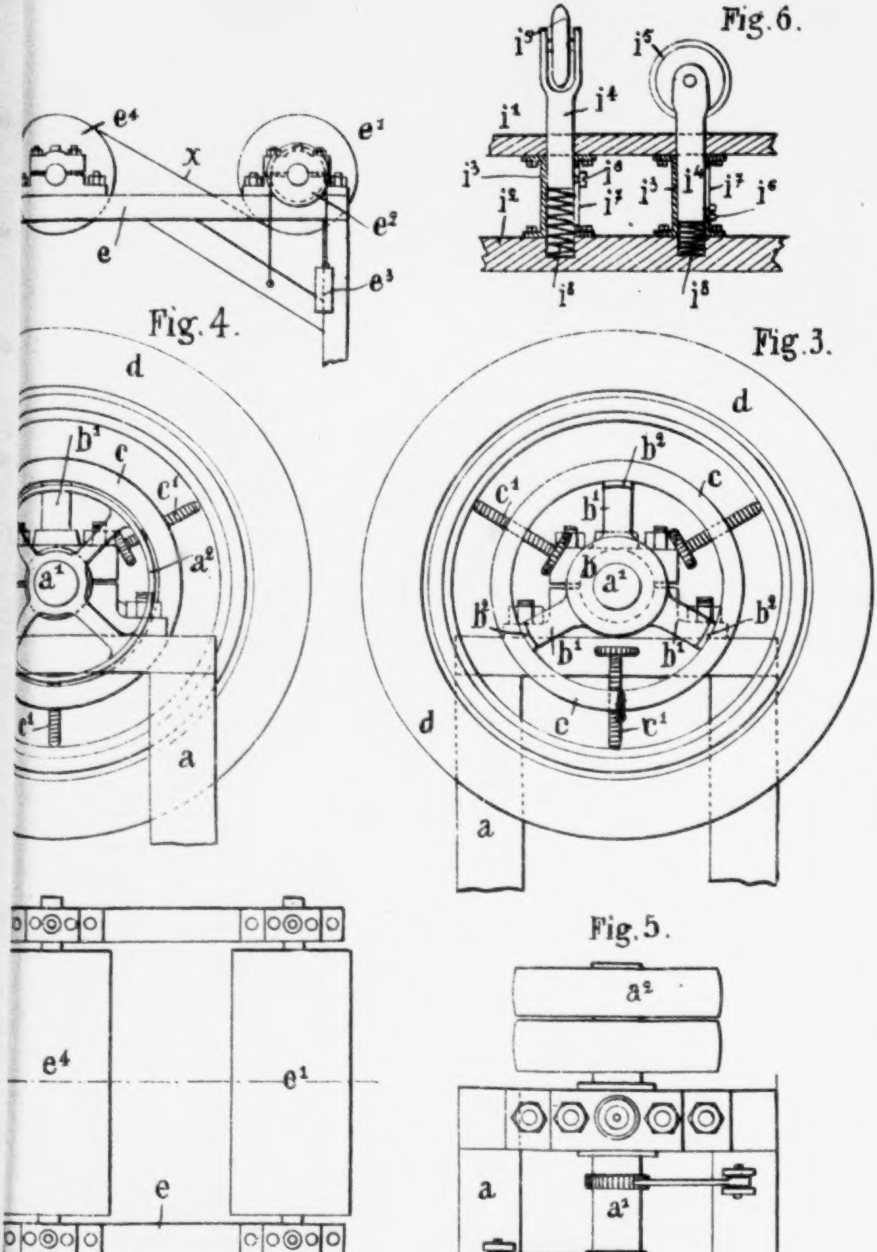


Fig. 6.
Fig. 4.
Fig. 3.
Fig. 5.
i^9 i^5 i^1 i^4 i^3 i^6 i^2 i^7 i^8
e^4 e^1 x e^2 e e^3
d b^1 c c^1 a^1 a^2 a
b^2 b
e^4 e^1 e e^3
a^2 a a^1 d c b^2 b^1 b

Defendant's Exhibit Q—Dewey Patent.

Defendant's Exhibit Q—Dewey Patent.

(No Model.)

M. W. DEWEY.

APPARATUS FOR FORMING OR SHAPING SHEET METAL ELECTRICALLY.

No. 438,407. Patented Oct. 14, 1890.

Fig. 2.

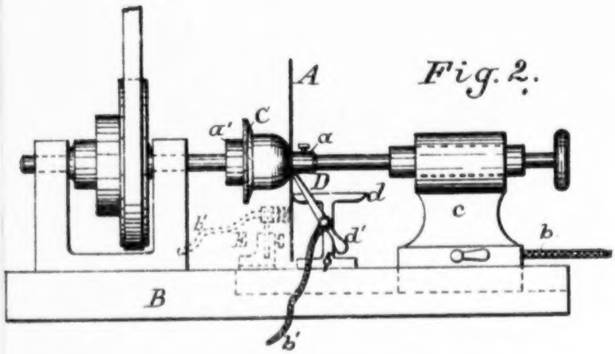


Fig. 1.

Fig. 3.

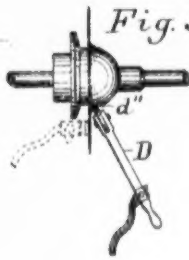


Fig. 4.

Fig. 5

Fig. 6.

Fig. 7.

Fig. 8.

WITNESSES:

C. L. Bendixon

H. M. Seamans

INVENTOR,

Mark W. Dewey,

BY

Duell, Laass & Duell,

his ATTORNEYS.

UNITED STATES PATENT OFFICE.

MARK W. DEWEY, OF SYRACUSE, NEW YORK, ASSIGNOR TO THE DEWEY CORPORATION, OF SAME PLACE.

APPARATUS FOR FORMING OR SHAPING SHEET METAL ELECTRICALLY.

SPECIFICATION forming part of Letters Patent No. 438,407, dated October 14, 1890.

Application filed July 28, 1890. Serial No. 360,122. (No model.)

To all whom it may concern:

Be it known that I, MARK W. DEWEY, of Syracuse, in the county of Onondaga, in the State of New York, have invented new and useful Improvements in Apparatus for Forming or Shaping Sheet Metal Electrically, (Case No. 67,) of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

My invention relates to certain apparatus for use in my process or method of forming sheet-metal articles which requires the employment of heat to soften or anneal the metal, and the application of pressure to gradually conform the sheet to the surface of a suitable die or mold.

Articles have been manufactured from sheet metal heretofore by successive and graduated pressing, depending on the depth of the article, and in some cases the metal was annealed after each pressing, as such pressing operation rapidly hardened it, which in turn caused the metal to tear and crack. Some metals, as German silver, are too brittle to be pressed to a great extent by this method. The process depends for its success upon the malleability of the metal; and it is the purpose of my invention to keep the metal annealed or in a softened condition during a greater part of if not the entire or complete formation of the article and to decrease the number of molds as well as the number of pressings usually required in forming or shaping the article, and also to save time and handling.

The object of my present invention is to provide apparatus or means for accomplishing my process or method which will produce more durable and superior sheet-metal ware, allow the formation of articles from thicker sheet metal and from various metals heretofore incapable of being pressed.

My invention consists in certain apparatus and devices hereinafter more particularly described and claimed, and useful in practicing the method set forth and claimed in another application for patent filed by me May 17, 1890, Serial No. 352,159; and it consists, essentially, in the combination, with a die or mold, of means for holding and rotating said die or mold with the sheet of metal to be operated upon, connections to pass an electric current through the sheet while it is rotated, and means for imparting pressure to the sheet to conform the same to the surface of said die or mold.

My invention consists, also, in certain other combination of apparatus hereinafter described, and specifically set forth in the claims.

In the accompanying drawings, Figure 1 is a side and edge view of a disk of sheet metal to be operated upon. Fig. 2 shows a side elevation of a lathe for holding the disk of sheet metal upon a mold and rotating the same while pressure is applied with an instrument to form said disk to the shape of the mold. Fig. 3 shows a sheet-metal article partly formed over the same mold. Fig. 4 represents the article completed. Figs. 5, 6, 7, and 8 are sectional views of a number of different-shaped articles that may be formed by my apparatus.

Referring specifically to the drawings, A in Fig. 2 is a sheet of thin metal, preferably in the form of a disk, as shown in Fig. 1, mounted upon a lathe B and held by pressure from a head-stock a against a mold C of the required form, fixed on the face-plate a' of the revolving spindle. The metal sheet may be cut into the form of a disk in any suitable manner either before or after said sheet is placed in position upon the mold in the lathe. The disk is preferably heated by passing a heating current of electricity through the same from a point at or near its center, or where the head-stock a bears against it, to the point where the pressure instrument or burnisher D is in contact with it. The pressure-instrument D may be of metal or some suitable non-conducting material. When said instrument is metallic, the current may be circulated through the apparatus, as shown, from the conductor b through the back head c, spindle, and head-stock a to the sheet A, through said sheet to the point where the instrument D is pressed against it, and through the instrument to and through the flexible conductor b', connected therewith, back to a suitable source of electricity, to which both conductors b and b' are connected.

When the instrument D is of non-conducting material, as bone or wood, or even when metallic, the current may be passed through an adjustable contact or brush E, bearing upon the disk, as shown in dotted lines in the figure. Said contact may be adjusted and moved to any desired position to make and maintain contact with the disk while it is rotated and formed into an article. The conductor b is then connected to the contact E, instead of the instrument D. Instead of passing the current through the lathe-spindle, another contact attached to the conductor b may be provided to bear upon the disk. The pressure-instrument D is held upon the lathe-rest d as a fulcrum, and while the disk A and mold C are revolved said instrument is applied to the disk near the center, which is rapidly bent or swaged, so as to fit close against the curved face of the mold. The instrument D may be held and moved [illegible] suitable means, but preferably in the [illegible] and by the handle d'. A gentle pressure is caused to bear on one point, thus producing a slight depression; but as the sheet is spinning at high velocity the depression at once forms a circle, and so by continuing the pressure of the instrument and gradually moving the same the sheet is molded into any form accordingly.

The mold C is preferably made of non-conducting material or of conducting material coated with a non-electric conducting material, as a mineral paint or enamel.

Various forms of pressure instruments or burnishers may be used, the one shown in Fig. 3 being provided with a roll d'' to decrease the friction between the bearing-points.

Sectional molds are employed when the form of the article, as shown in Fig. 6, will not permit the removal of a solid mold after the article is formed or spun over the mold. It will be also apparent that the sheet of metal may be by this method maintained in a heated, softened, or annealed condition during the entire formation of the article, if desired, and that with suitable current-regulating devices in circuit the sheet may be kept at any temperature desired without danger of burning or heating the sheet metal too much.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an electric apparatus for forming sheet-metal articles, the combination, with a die or mold, of means for holding and rotating said die or mold with the sheet of metal to be operated upon, connections to pass an electric current through the sheet while it is rotated, and means for imparting pressure to the sheet to conform the same to the surface of said die or mold.

2. In an electric apparatus for forming sheet-metal articles, the combination, with a suitable die or mold, of means for holding and rotating said die or mold with the sheet of metal to be operated upon, a pressure-instrument to gradually conform the sheet to the form of the surface of the said mold, and terminals of an electric circuit in contact with the sheet, one at its center or axis and the other at a point nearer the edge or periphery of the sheet.

3. In an electric apparatus for forming sheet-metal articles, the combination, with a suitable die or mold, of means for holding and rotating said die or mold with the sheet of metal to be operated upon, a pressure-instrument to gradually conform the sheet to the form of the surface of the said mold, and terminals of an electric circuit connected to the sheet, one terminal constituting the head-stock of the rotating means and the other terminal the pressure-instrument.

4. In an electric apparatus for forming sheet-metal articles, the combination, with a suitable die or mold, of means for holding and rotating said die or mold with the sheet of metal to be operated upon, a pressure-instrument having a revolving bearing to gradually conform the sheet to the form of the surface of the said mold, and terminals of an electric circuit in contact with the sheet.

5. In an electric apparatus for forming sheet-metal articles, the combination, with a suitable die or mold, of means for holding and rotating said die or mold with the sheet of metal to be operated upon, a universally-movable pressure-instrument to gradually conform the sheet to the form of the surface of the said mold, and terminals of an electric circuit in contact with the sheet.

6. In an apparatus for electrically forming sheet-metal articles, the combination of a die or mold, means for holding the sheet against said die or mold, and a movable pressure-instrument to conform the sheet to the shape of the surface of the mold, and electric terminals in contact with the sheet.

7. In an apparatus for electrically forming sheet-metal articles, the combination of a die or mold, means for holding the sheet against said die or mold, and a movable pressure-instrument to conform the sheet to the shape of the surface of the mold, and electric connections leading to said means for holding the sheet against the mold and to the movable pressure-instrument.

In testimony whereof I have hereunto signed my name this 26th day of July, 1890.

MARK W. DEWEY. [L. S.]

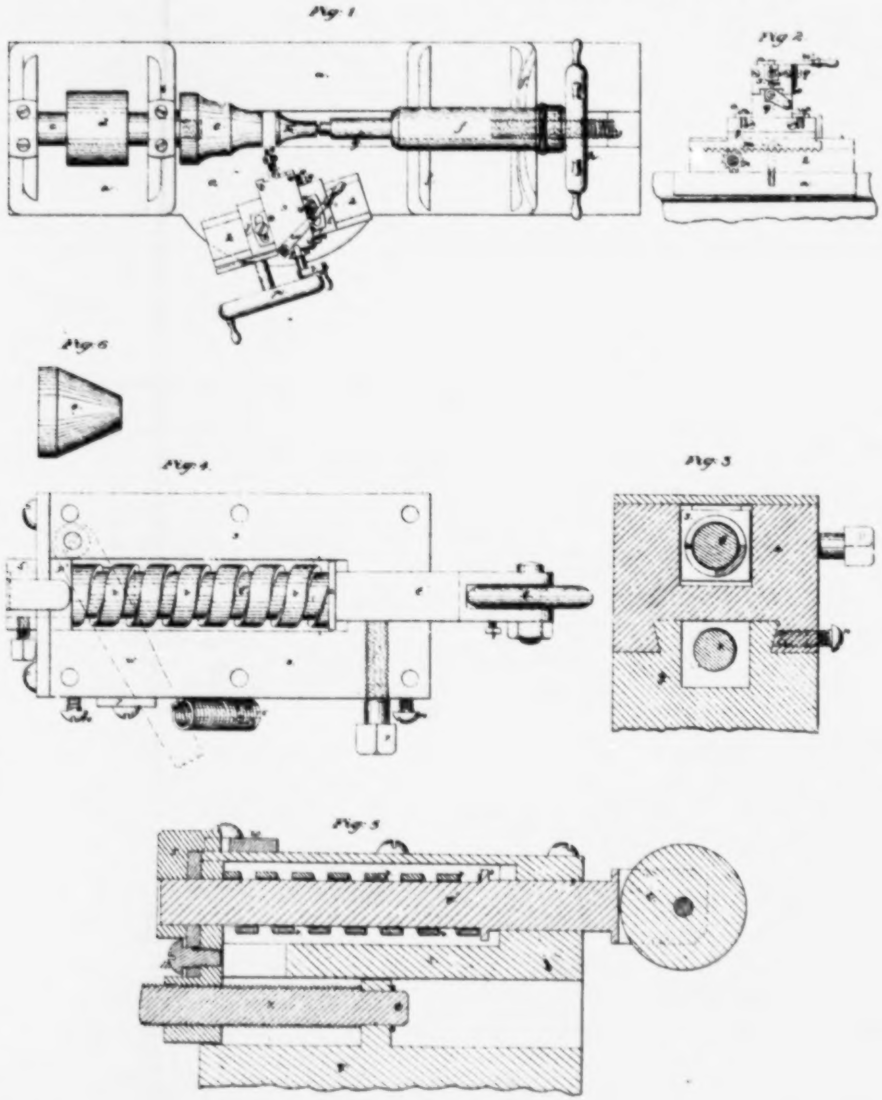
Witnesses:
C. H. DUELL,
H. M. SEAMANS.

Defendant's Exhibit R—Early Seymour Patent.

F. J. Seymour.

Spinning Metals.

N° 80,836. Patented Aug. 11, 1868.



Witnesses

Inventor

United States Patent Office.

FREDERICK J. SEYMOUR, OF WOLCOTTVILLE, ASSIGNOR TO HIMSELF AND E. MILLER AND COMPANY, OF MERIDEN, CONNECTICUT.

Letters Patent No. 80,836, *dated August* 11, 1868.

IMPROVEMENT IN MACHINE FOR BURNISHING AND SPINNING METALS.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, FREDERICK J. SEYMOUR, of Wolcottville, in the county of Litchfield, and State of Connecticut, have invented, made, and applied to use a certain new and useful Improvement in Machinery for Spinning or Burnishing Articles of Sheet Metal; and I do hereby declare the following to be a full, clear, and exact description of the said invention, reference being had to the annexed drawing, making part of this specification, wherein—

Figure 1 is a plan of my said machine complete.

Figure 2 is an elevation of the tool-holding slide-rest.

Figure 3 is a section of the tool-stock and slide.

Figure 4 is a plan of the tool-stock and slide with the cap-plate removed.

Figure 5 is a longitudinal section of the tool-stock and parts that operate on the same, and

Figure 6 is an elevation of a conical former, that may be used for giving shape to the article to be made in its first stages.

Similar marks of reference denote the same parts.

Machines have heretofore been made for operating upon disks of sheet metal, to spin them up to the shape of a chuck or former, the said chuck or former and the sheet metal revolving against a roller that is held to said sheet metal by a slide-rest, to which motion is given to cause the roller to move along the surface of the chuck or former, as may be seen in the French patent of Japy Brothers, dated March 1, 1836.

The nature of my said invention consists in mechanism for holding a roll or burnisher with a yielding or elastic power against the revolving sheet metal and former, so that the spinning up of articles of sheet metal can be done with a tool that is held by mechanism that will yield to the curvatures of the former or chuck, and operate similarly to the spinning of sheet-metal articles by hand.

By my mechanism, irregular shapes, such as used for lamps, oil-cans, &c., can be spun up with great speed and precision by a workman with but little experience or bodily strength, while the spinning of large articles of sheet metal has heretofore required a workman with considerable experience and bodily strength to hold the tool.

My improvements are adapted to spinning up of regular conical articles in sheet metal, but are more particularly available in spinning up ornamental articles formed with curved sides or angular bends, forming bands or varying-shaped circular articles, now spun up by hand or pressed up in dies.

In the drawing, *a* is the bed of the machine, carrying the head *b*, that supports the mandrel *c*, upon which is a pulley, *d*, driven by competent power.

e is the chuck or former, of the desired shape, corresponding with the interior of the lamp-reservoir or other article to be produced. This former *e* is screwed upon the end of the mandrel *c*, and can be changed as required for different articles, or for different stages of the same article.

f is the movable head, carrying the sliding mandrel *g*, set up by the hand-wheel *h*, to clamp the disk of metal between the clamping-head or whirl *h'* and the former *e*.

Upon the top of the bed *a* is a bed, *k*, forming a slide for the tool-holding mechanism, and this bed *k* may be turned to any desired angle to the centre line of the machine, so as to be parallel, or nearly so, with the general outline of the article to be formed, as illustrated in fig. 1.

The bed *k* is attached by a bolt near the centre thereof, as shown by dotted lines in fig. 2.

Upon the top of the bed *k* are V-slides, receiving the secondary bed, *l*, with a rack, *m*, on one side, acted upon by the pinion *n*, that is moved by the hand-wheel *p*, so that the tool, and the slide-rests carrying the same, can be moved along over the surface of the sheet metal by turning said wheel *p* and sliding the secondary bed *l* along on the bed *k*.

The slide-rest *q* is attached to the secondary bed *l* by the slots and screws *o*, so that it can be secured at

any desired angle to the said bed l, for regulating the direction in which the roller or burnishing-tool and its stock stands to the metal operated upon.

The tool-holding slide s is fitted to move endwise upon V-slides, upon the rest q, and r is the screw and handle that operates upon the nut r' to move the slide s.

The tool t is mounted at the end of the stock t', that is fitted to slide endwise through the slide s, and within said slide s the spring v operates, between the upper end of the nut r' and a shoulder, 3, to project the tool t, but if the pressure upon the tool becomes too great, the spring v yields, and allows the tool and stock to move back, and thus the tool is made to follow up the sheet metal, and keep it into contact with the surface of the chuck or former, whatever the shape of that former may be, the parts being properly set to operate in connection with the particular former.

When the tool is to be moved along again to the right, to commence a second operation, the stock t' is to be drawn back by the lever w, (see fig. 1 and red lines, fig. 4,) acting against a toe that projects from the collar 5, that is attached to the back end of the stock t', and a spring, 6, draws said lever down to latch it behind the catch 7. The raising of this lever to unlatch it, when the tool is opposite the place of beginning on the disk or article of sheet metal, allows the spring v to project the tool for proceeding as before.

In burnishing articles of sheet metal, I find it best to use the roll t, kept from turning by a set-screw at 8, as a circular burnisher of this character can be kept in order with great facility.

The stock t' can be clamped, so that the tool will be rigid, by the screw 9. This may be employed where a straight-sided conical article is being spun up, especially where it is desired to reduce the thickness of the metal during the spinning operation.

If the parts are adjusted to a given movement, and it is desired to make the spring v more powerful in its operation, the screws 10 may be tightened to fasten the tool-slide s immovably to the slide-rest q, and then, by turning the screw r, the nut r' will compress the spring v.

I prefer to use a screw at 11, to hold the nut r' back to its place, under ordinary circumstances. This screw 11 is to be slackened or removed when the spring is rendered more powerful by the movement of the nut r'.

By the apparatus constructed as aforesaid, the workman is relieved from the labor of holding the tool while the spinning operation is performed, and he is able to guide and direct his tool with precision, in a manner corresponding generally to that employed in turning metals with a slide-rest; and, in addition to the yielding force applied to the tool, to cause it to conform to the shape of the chuck or former, the screw r and hand-wheel p place the tool under the direction of the attendant, and if the spring v is too powerful for any particular character of work, its force may be lessened by the hand acting to draw back the lever w.

What I claim, and desire to secure by Letters Patent, is—

1. A revolving chuck or former, in combination with a tool fitted to yield and moved automatically, in spinning or burnishing articles of sheet metal upon said chuck or former, substantially as formed.

2. The lever w, in combination with the tool t, stock t', and spring for withdrawing said tool from the work, as set forth.

3. The roll t and set-screw 8, for converting said roll into a burnisher, as and for the purposes set forth.

4. The arrangement of the tool-holding slide s, nut r', screw r, and slide-rest q, and screws 10 10 10, for the purposes and as set forth.

5. The tool-holding slide s, tool t, spring v, lever w, slide-rest q, secondary bed l, bed k, and hand-wheel p, arranged and applied substantially as specified, for spinning or burnishing articles of sheet metal upon a revolving chuck or former, as set forth.

In witness whereof, I have hereunto set my signature, this fifth day of May, 1868.

FRED'K J. SEYMOUR.

Witnesses:

W. H. PERKINS,

EBENEZER GILBERT.

Defendant's Exhibit S—Later Seymour Patent.

(No Model.)

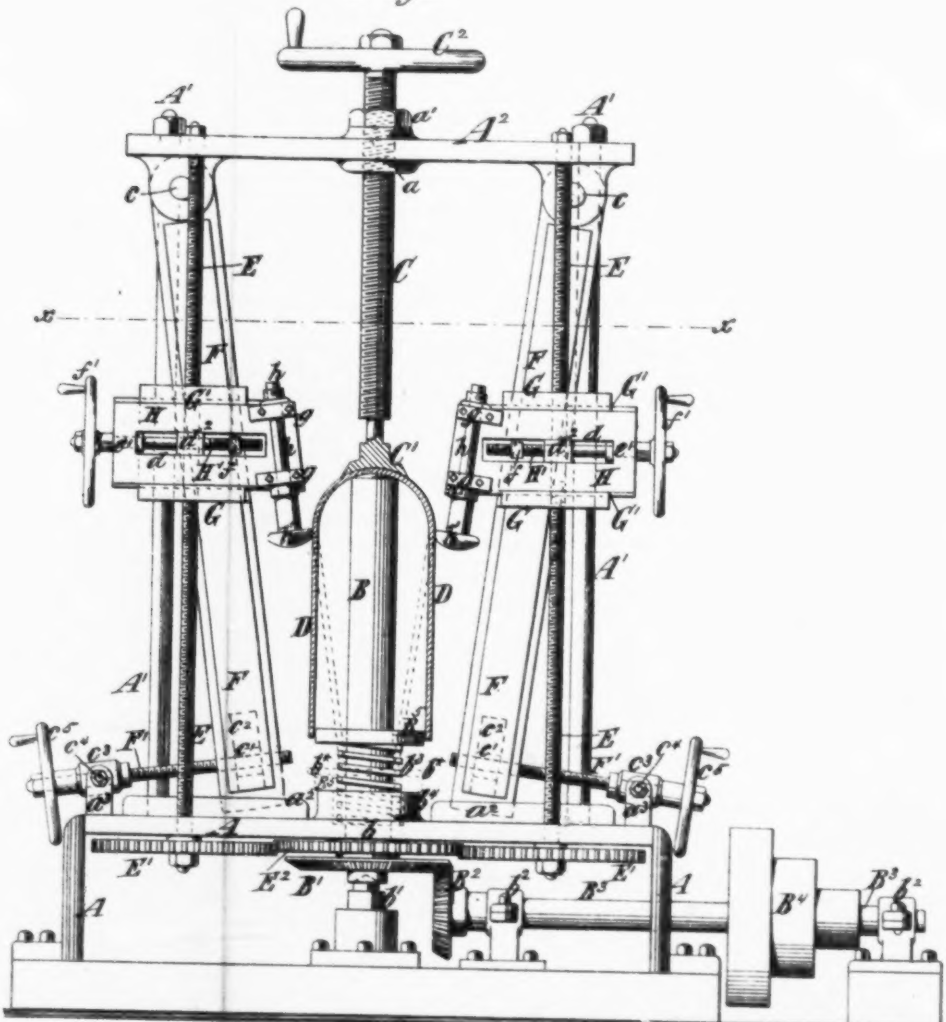
2 Sheets—Sheet 1.

F. J. SEYMOUR.

MACHINE FOR SHAPING WROUGHT METAL CYLINDERS.

No. 376,167. Patented Jan. 10, 1888.

Fig 1.



Witnesses:
Matthew Pollock
Fred Haynes

Inventor:
Fredk J Seymour
by his Attys.
Brown & Hall

(No Model.) 2 Sheets—Sheet 2.

F. J. SEYMOUR.

MACHINE FOR SHAPING WROUGHT METAL CYLINDERS.

No. 376,167. Patented Jan. 10, 1888.

Fig 2

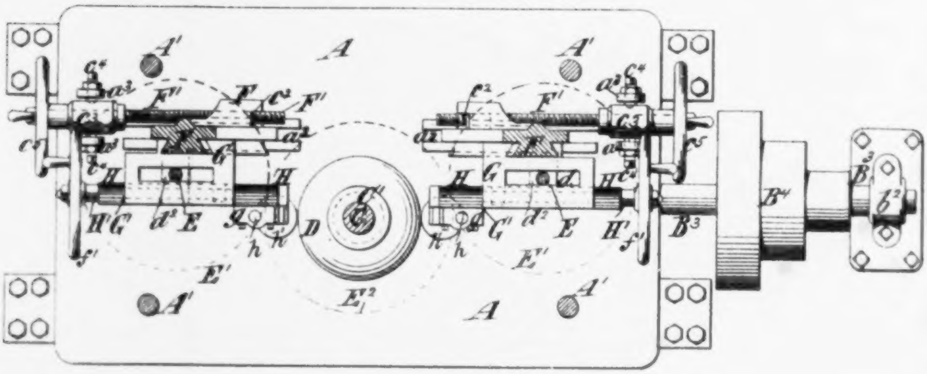
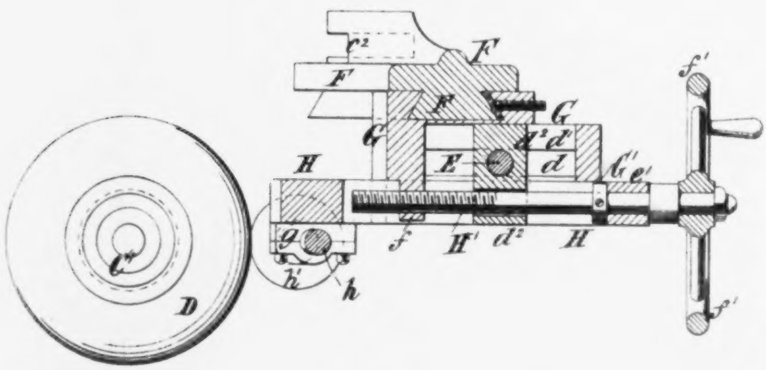


Fig 3.



Witnesses:
Matthew Pollock
Fred Haynes

Inventor
Fredk J. Seymour
by his Attys
Brown & Hall

UNITED STATES PATENT OFFICE.

FREDERICK J. SEYMOUR, OF CLEVELAND, OHIO, ASSIGNOR TO THE BROWN'S SEAMLESS METAL COMPANY, OF JERSEY CITY, NEW JERSEY.

MACHINE FOR SHAPING WROUGHT-METAL CYLINDERS.

SPECIFICATION forming part of Letters Patent No. 376,167, dated January 10, 1888.

Application filed June 15, 1885. Renewed June 17, 1887. Serial No. 241,610. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK J. SEYMOUR, of Cleveland, in the county of Cuyahoga and State of Ohio, have invented a new and useful Improvement in Machines for Shaping Wrought-Metal Cylinders or Shells, of which the following is a specification.

The object of my invention is to provide a machine whereby cylinders of steel, copper, or other wrought metal, and particularly cylinders closed and rounded at one end, may be rapidly and accurately contracted in diameter, either for the purpose of giving them a tapering form or for the purpose of contracting or shrinking them from end to end. The machine may be employed for operating upon such cylindric shells or cylinders either in a heated or cold state, and it is particularly useful for forming from such a cylinder an air-chamber having a downwardly-tapered form and necked, or having an outwardly-projecting flange at the lower open end. In this way air-chambers for pumps and other apparatus may be produced of thin steel or copper of great tensile strength and finely finished. The machine may also be employed for the purpose of contracting a number of cylindric shells one upon another, in order to make therefrom a piece of ordnance or cannon, each cylindric shell forming a mandrel upon which the next outer cylindric shell is tightly and permanently contracted.

This machine comprises a base portion or bed-plate, upon which are erected columns or posts, and a head or top plate surmounting such columns or posts. It also has a central rotary mandrel or spindle, upon which the cylinder to be operated upon is placed, and a rotary and screw-actuated steadiment, which may be brought down upon the closed end of the cylinder to hold it upon the mandrel or spindle. By the rotation of the mandrel or spindle the cylindric shell to be operated upon, whether in a heated or cold state, is turned or rotated. At opposite sides of the central mandrel or spindle are two carriages, each containing a slide having mounted upon it a rotary wheel or tool, and by means of ver- [...] these carriages and their slides [are] moved upward and downward or traversed along the cylinder. The two carriages are mounted upon slideways or guides, which may be pivoted at one end, as at the top, and adjustable by means of adjusting-screws toward and from the central mandrel or spindle at their lower ends. As the carriages and their slides and tools are traversed up or down by the feed-screws, they will follow the direction of these slideways or guide-bars, and if the slideways or guide-bars are set with an inward inclination toward the central mandrel or spindle the carriages and their slides and tools as they traverse downward will be gradually moved inward toward the mandrel or spindle, and will thereby impart to the cylindric shell operated upon a downward-tapering form, such as would be required for the air-chamber of a pump. By means of the adjusting screws, which are at the lower end of the guide-bars, they may be set inward or outward relatively to the central mandrel or spindle, so that the spinning tools or wheels will be moved downward in lines parallel with the mandrel or spindle for producing straight work, or in lines more or less inclined relatively to the central axis for producing a downward taper or downwardly-flaring work.

In the accompanying drawings, Figure 1 is a front elevation of a machine embodying my invention. Fig. 2 is a horizontal section thereof upon the plane of the dotted line x x, Fig. 1, and Fig. 3 is a sectional view, upon a larger scale, through one of the guide-bars, its carriage, and slide, and showing also in plan a cylindric shell which is to be operated on.

Similar letters of reference designate corresponding parts in the several figures.

A designates a base-plate or bed, which may be of cast metal, and B designates a central mandrel or spindle, which projects upward through and is fitted to a suitable bearing, b, in the bed A. This mandrel or spindle also has a step-bearing, b', of any suitable construction, and has upon its lower end a bevel-wheel, B', with which engages a bevel-wheel, B^2, upon a driving-shaft, B^3. This driving-shaft is mounted in bearings b^2, and has upon it a cone-pulley, B^4, adapted to receive a driving-belt for operating the machine. Upon the mandrel or spindle B is fitted a follower or ring, B^5,

below which is a spiral spring, b^3, whereby the follower or ring B^3 is supported. This spring b^3 is capable of yielding downward, so as to be received within a chamber or cavity formed in the hub b^4 upon the top of the base A, and the follower or ring B^3 will or may come down to a bearing upon the top of this hub or projection, as is represented by dotted lines in Fig. 1.

Erected upon the base-plate or bed A are upright posts or columns A′, which are rigidly connected at their upper ends with a head or top plate, A^2, the base A, columns A′, and head A^2 forming the rigid frame work of the machine.

The top plate or head, A^2, has formed in it, in vertical alignment with the mandrel or spindle B, a nut, a, and to this nut is fitted an upright screw, C, which is concentric with the mandrel or spindle, and which has fitted in its lower end a rotary steadiment or foot, C′, which comes just above the top of the mandrel.

D designates the cylindric shell which is to be operated upon, and which, as here shown, is closed by a hemispherical head or end portion. This shell is placed upon the mandrel, and the follower or ring B^3 should be of such size as to enter and receive upon it the lower open end of the cylindric shell. The shell rests upon the top of the mandrel or spindle B, and by bringing the foot or steadiment C′ down against the outside thereof by turning the screw, the cylindric shell will be held in place and will be clamped to the end of the spindle or mandrel, so that it will rotate therewith. In order to prevent the accidental unscrewing of the tightening screw C, I provide it with a lock-nut, a', and it may be turned by means of the hand-wheel or handle C^2.

E E designate two upright feed-screws, which are supported in suitable bearings in the bed A and top plate or head, A^2, and which have spur-wheels E′ upon their lower ends. The wheels E′ engage with and are driven by a wheel, E^2, fast upon the mandrel or spindle B, and through them the feed-screws E receive rotary motion.

Extending from top to bottom of the machine are guide-bars F, which, as here represented, are pivotally connected at c to the head or top plate, A^2, and have their lower ends adjustable toward and from the mandrel or spindle B, so that they may be set into positions inclined more or less relatively thereto.

As here represented, the bed or base A has upon it pairs of upwardly-projecting flanges, which form between them slideways a^2, in which the lower ends of the guide-bars F are held, and by which lateral motion of the guide-bars in a direction transverse to their line of adjustment is prevented.

F′ designates adjusting-screws, which engage with nuts c', fitting to slideways c^2 in the lower ends of the guide-bars F. These adjusting-screws are fitted to bearings c^3, which are pivoted or supported by trunnions c^4 in lugs or ears a^3 upon the bed A, and the screws may be turned by hand-wheel c^5. The bearings c^3 and the sliding nuts c' accommodate themselves to the varying positions of the guide-bars F, and by turning these screws F′ in one direction or the other the guide-bars F may be swung upon their pivots c and brought into positions parallel with the mandrel or spindle B, or at any desired inclination thereto, either toward or from the mandrel.

As best represented in Figs. 2 and 3, each guide-bar F has a dovetailed rib or slideway upon its face, and to this slideway is fitted a carriage, G, which has dovetailed gibs fitting the slideway, and is capable of adjustment upward and downward thereon. Each carriage is formed with a vertical slot, d, which receives through it the feed screw E, and it also has a horizontal slot, d', in which is fitted a sliding nut, d^2, which is fitted upon the feed-screw E. As the feed-screw is rotated, the nut, being prevented from turning, will be moved up or down, and will thereby impart a vertical traverse motion to the carriage G; but the slots d d' will permit of the carriage G moving freely in a lateral direction to accommodate itself to the inclination of the guide-bar F.

In the face of each carriage is a dovetailed slideway, G′, wherein is fitted a horizontally-moving slide, H, as best shown in Fig. 1. This slide H may be adjusted laterally relative to the carriage G by means of a screw, H′, which is held against lengthwise movement in a bearing, e', and engages with a nut, f, projecting forward from the carriage G, as will be seen in Fig. 3. The screw H′ may be turned by a hand-wheel or handle, f', and by so turning the screw the slide H will be moved laterally in the carriage G, inward or outward relatively to the mandrel or spindle B. The screw H′ connects the carriage and slide G H, so that as the carriage is moved upward or downward the slide will be moved with it, and will be held against accidental lateral movement. Upon the slide H are bearings g, in which is mounted a rotary spindle, h, carrying at its lower end a disk or spinning-tool, h'. As here represented, the spindles h are inclined inward and downward relatively to the mandrel B, so that as they move upward or downward their tools h' will bear upon the cylinder D, while permitting the bearings g and slide H to clear the cylinder D.

The spindles h and the spinning-tools h' are free to rotate by their frictional contact with the positively-driven cylinder, and as they are traversed upward and downward they contract the cylinder D, and also have a tendency to correspondingly elongate it. If the guide-bars F are set to inclined positions, as shown in Fig. 1, the carriages G and tools h' will move gradually inward toward he mandrel B as the carriages are moved downward, and will thereby contract the cylinder, so that its walls when finished will be parallel with the position of the guide-bars F.

The machine as shown is adjusted for drawin

downward and necking the cylinder, so as to form an air-chamber having a flange, b^*, at its lower end, as shown by dotted lines, Fig. 1. After the tools h' have been moved downward and have completed their work, the screws H′ may be slightly slackened, so as to move the tools h' from the work, and then by rotating the driving-shaft B^3 and the feed-screws E in a reverse direction to their former rotation the carriages G and the tools h' will be traversed upward, or returned to a position for a new operation. The mechanism for reversing the direction of the driving shaft B^3 and the feed-screws E may be of any suitable character ordinarily used in analogous machines. A convenient arrangement of mechanism will be to employ a simple counter-shaft, such as is used for driving a lathe, and which is driven by open and crossed belts capable of being shipped, or by a clutch arranged so that they may be employed in driving the counter shaft in one or other direction, as may be desired. A single belt driving from the cone on the counter-shaft onto the cone B^4 of the driving-shaft will complete the driving-gear. I have not shown the counter-shaft with its pulleys, as they are similar to the counter-shafts and pulleys ordinarily employed in driving lathes.

The cylinder or cylindric shell D may be brought to the form shown by full lines in Fig. 1, preparatory to operating upon it by this machine, by drawing with suitable dies and mandrels, and either in a heated or cold state, or in both a heated and cold state, the first drawing or folding operations being performed while the metal is heated, and the subsequent drawing operations being performed while the metal is in a cold state. The cylindric shell D may be operated upon by my improved machine either in a hot or cold state.

Not only may the machine be employed successfully in giving a downwardly-tapering form to the work D, so as to form air-chambers or other analogous or tapering articles, whether they have flanges at their lower ends or not, but it may be also employed in contracting more or less the diameter of cylindric sections, leaving them straight and of uniform diameter from end to end. The machine may in this way be employed to bind together a number of cylindric shells of different diameters, so as to form a composite gun or piece of ordnance. The shells may be made of such relative diameters by drawing that they will slip one within another, and they may by this machine be contracted one upon another, and by a number of successive operations, each cylinder forming a mandrel on which the cylinder outside it is contracted and permanently secured.

Such a method of forming a gun or piece of ordnance by contracting cylindric sections or shells one upon another is not included in this invention, but forms the subject of a separate application for Letters Patent, Serial No. 168,701, filed June 15, 1885.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The combination, with an upright rotary mandrel or spindle adapted to receive and carry a cylindric shell or tube, of guide-bars extending upward and downward at opposite sides thereof, carriages fitting the guide-bars and provided with spinning tools or disks for operating on the shell or tube, feed-screws and nuts for traversing the carriages upward and downward along the guide-bars in a direction lengthwise of the mandrel or spindle, and gearing connecting the feed-screws, whereby they are caused to rotate in unison, substantially as herein described.

2. The combination, with the central rotary mandrel or spindle, B, and a sliding follower or ring, B^5, fitted thereto and adapted to support a cylindric shell or tube, of guiding-bars, feed-screws, and carriages arranged at opposite sides of the mandrel or spindle, and spinning tools or disks on the carriages for operating upon the cylindric shell or tube, substantially as herein described.

3. The combination, with a base-frame and top frame or head and posts connecting them, of a rotary upright mandrel or spindle journaled in the base-frame, the oppositely-arranged holding screw C, fitting a nut in the top frame or head and provided at the lower end with a rotary foot or steadiment, C′, guide-bars F, extending between the base-frame and top frame or head, on opposite sides of the mandrel or spindle, carriages fitted to reciprocate upward and downward along the guide-bars and provided with spinning tools or disks, and feed-screws and nuts for reciprocating the carriages and their tools along the guide-bars, substantially as herein described.

4. The combination, with the central rotary mandrel or spindle, B, the follower or ring B^5, fitted to slide upon the mandrel or spindle, and the spring b^3, for supporting the follower or ring, of guiding-bars or slideways and carriages fitted to slide thereon, spinning tools or disks upon said carriages, and feed-screws and nuts, whereby said carriages, with their tools, will be traversed along lengthwise of the mandrel or spindle, substantially as herein described.

5. The combination, with a central rotary mandrel or spindle for receiving and carrying a cylindric shell or tube, of pivoted guiding-bars or slideways and adjusting-screws, whereby said bars or slideways may be set and held stationary in positions parallel with or at any desired inclination to said mandrel or spindle, carriages fitted to said guiding-bars or slideways and carrying spinning tools or disks, feed-screws and nuts, whereby said carriages, with their tools, may be traversed along the guiding-bars or slideways in a direction lengthwise of the mandrel or spindle, and gearing connecting the feed-screws, whereby they are made to rotate in unison, substantially as herein described.

6. The combination, with the central rotary mandrel or spindle, B, of the guiding-bars F, pivoted at their upper ends, and adjusting-screws F′, engaging with nuts at the lower ends of the said bars, swiveled bearings c^3 for said screws, carriages fitted to reciprocate on said guiding-bars and carrying spinning tools or disks, and feed-screws and nuts, whereby said carriages, with their tools, may be traversed along said guiding-bars, substantially as herein described.

7. The combination, with the central upright mandrel or spindle, B, and the oppositely-arranged holding-screw and steadiment C C′, of guide-bars F, extending upward and downward on opposite sides of the mandrel or spindle and the vertical feed-screws E, the carriages G, each fitting a guide-bar and having a horizontal slideway, G′, in its face, and also having a vertical slot, d, for the reception of a feed-screw, E, and a horizontal slot, d', the nuts d^2, each fitting a feed screw and received in the slot d' of a carriage, G, the slides H, and screws H′, for adjusting them in their slideways G′, and the tools or disks carried by said slides, substantially as herein described.

FREDK. J. SEYMOUR.

Witnesses:

P. W. PAYNE,

M. P. SEARS.

adjustment is prevent…

F′ designates adjusting …

with nuts c', fitting to slidew…

…s of the guide-bars F. T…

are fitted to bearings c^3, …

…pported by trunnions

Defendant's Exhibit U—State File Wrapper.
(Extracts only.)

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-19-

Sub A

1. An open tire-shoe making machine comprising the combination of a power-driven ring-core, and a pair of stock-rolls for carrying strips of sheeted ~~rubber-coated~~ fabric having their threads at an angle for alternate application to the core, substantially as described.

Substitute B²

2. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a transversely movable support, and a pair of stock-rolls, for carrying strips of sheeted ~~rubber-coated~~ fabric having their threads at an angle, mounted on the support for alternate juxtaposition to the ring-core, substantially as described.

3. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a rotary support, and a pair of stock-rolls, for carrying strips of sheeted ~~rubber-coated~~ fabric having their threads at an angle, mounted on the support for alternate juxtaposition to the core, substantially as described.

4. An open tire-shoe making machine comprising the combination of a sheet fabric supply, a power-driven ring-core, a radially moving and laterally yielding spring-pressed support, and a spinning-roll mounted on the support for passing along the sides of the tire-shoe to shape them on the core, substantially as described.

5. An open tire-shoe making machine comprising the combination of a sheet fabric supply a power-driven ring-core, a radially moving and laterally yielding spring-pressed support, and a spinning-roll mounted on the support at a receding angle to the plane of the core for passing along the sides of the tire-shoe to shape them on the core, substantially as described.

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6. An open tire-shoe making machine comprising the combination of a sheet fabric supply a power-driven ring-core, a radially moving and laterally yielding spring-pressed support, and a spinning-roll having a rounded, disc-shaped working edge mounted on the support for passing along the sides of the tire-shoe to shape them on the core, substantially as described.

" "

7. An open tire-shoe making machine comprising the combination of a sheet fabric supply a power-driven ring-core, a radially moving and laterally yielding spring-pressed support, and a spinning-roll having a rounded disc-shaped working edge mounted on the support at a receding angle to the plane of the core for passing along the sides of the tire-shoe to shape them on the core, substantially as described.

" "

8. An open tire-shoe making machine comprising the combination of a sheet fabric supply a power-driven ring-core, a radially moving tread-forming-roll for shaping the tire portion of the tire, a radially moving and laterally yielding spring-pressed support, and a spinning-roll mounted on the support to pass along the sides of the tire-shoe to shape them on the core, substantially as described.

" "

9. An open tire-shoe making machine comprising the combination of a sheet fabric supply a power-driven ring-core and a transversely and radially movable support carrying both a tread-forming-roll for shaping the outer portion of the tire and a laterally yielding spring-pressed spinning-roll for passing over the sides of the tire-shoe to shape them on the core, which rolls are alternately juxtaposed to the ring-core, substantially as described.

"

10 An open tire-shoe making machine comprising the combination of a sheet fabric supply a power-driven ring-core, and a radially movable rotary support carrying a tread-forming-roll for shaping the outer portion of the tire-shoe and a laterally yielding

spinning-roll for passing along the sides of the tire-shoe to shape them on the core, substantially as described.

11. An open tire-shoe making macnine comprising the combination of a stock-roll for carrying a strip of
per A sheeted ~~rubber-coated~~ fabric, a ring-core, a slow-speed mechanism for actuating the core when receiving fabric from the stock-roll, a forming-roll, a fast-speed mechanism for actuating the ring-core during the operation of the forming-roll, and speed-changing mechanism, substantially as described.

12. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of
" " sheeted ~~rubber-coated~~ fabric, a ring-core, a slow-speed mechanism for actuating the core when receiving fabric from the stock-roll, a radially moving and laterally yielding spring-pressed spinning-roll for passing over the sides of the tire-shoe to shape them on the core, fast-speed mechanism for actuating the ring-core during the operation of the spinning-roll, and speed-changing mechanism, substantially as described.

13. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of
" " ~~rubber-coated~~ sheeted fabric, a ring-core, a slow-speed mechanism for actuating the core when receiving fabric from the stock-roll, a radially moving and laterally yielding spring-pressed support, a spinning-roll mounted on the support at a receding angle to the ring-core to pass over the sides of the tire-shoe to shape them on the core, a fast-speed mechanism for actuating the ring-core during the operation of the spinning-roll, and speed-changing mechanism, substantially as described.

14. An open tire-shoe making machine comprising
" " the combination of a stock-roll for carrying a strip of sheeted ~~rubber-coated~~ fabric, a ring-core, a slow-speed mechanism for actuating the core when receiving fabric from the stock-roll,

a radially and transversely movable support, a tread-forming-roll and a laterally yielding spinning-roll for passing over the sides of the tire-shoe mounted thereon, fast-speed mechanism for actuating the ring-core during the operation of the spinning-roll, and speed-changing mechanism, substantially as described.

15. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a stock-roll for carrying a spiral winding of rubber-coated fabric and muslin, and a take-up roll for taking up the muslin as the rubber-coated fabric is drawn onto the ring-core, substantially as described.

16. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a stock-roll for carrying a spiral winding of rubber-coated fabric and muslin, and a yieldingly mounted take-up roll frictionally engaging the material on the stock-roll, whereby the muslin is taken up as the rubber-coated fabric is drawn onto the ring-core, substantially as described.

17. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a stock-roll for carrying a strip of rubber-coated fabric, and a stretching-roll provided with divergent spirally arranged sets of grooves, whereby the longitudinal creases are taken out of the fabric in its passage to the ring-core, substantially as described.

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18. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a stock-roll for carrying rubber-coated fabric, a tension-roll and a stretching-roll provided with divergent, spirally arranged sets of grooves, whereby the longitudinal creases are taken out of the fabric and it is smoothly and evenly applied to the ring-core, substantially as described.

per B 19. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a movable head, and two sets of rolls for alternate juxtaposition to the core, each set comprising the stock-roll for carrying a strip of ~~rubber coated~~ sheeted fabric having its threads at an angle and a tension-roll over which the fabric passes on its way to the core, substantially as described.

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per A 20. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a stock-roll for carrying rubber-coated fabric and a tension-roll covered with a layer of vulcanized rubber, substantially as described.

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per B 20 ~~21.~~ An open tire-shoe making machine comprising the combination of a power-driven ring-core, a stock-roll for carrying ~~rubber coated~~ sheeted fabric, a tension-roll over and around which the fabric passes, and a stretching-roll under which the fabric runs, substantially as described.

" " 21 ~~22.~~ An open tire-shoe making machine comprising the combination of a power-driven ring-core, a movable head, and two sets of rolls for alternate juxtaposition to the core, each set comprising a stock-roll for carrying a strip of ~~rubber coated~~ sheeted fabric having its threads at an angle, and a stretching-roll provided with divergent, spirally arranged sets of grooves over which the fabric passes on its way to the core, substantially as described.

" " 22 ~~23.~~ An open tire-shoe making machine comprising the combination of a power-driven ring-core, a movable head and two sets of rolls for alternate juxtaposition to the core each set comprising a stock-roll for carrying a strip of ~~rubber coated~~ sheeted fabr ic having its threads at an angle, a tension-roll and a stretching-roll over which the fabric passes on its way to the core, substantially as described.

23 ~~25.~~ An open tire-shoe making machine comprising the combination of two power-driven ring-cores, a rotary head, a pair of stock-rolls mounted thereon for alternate juxtaposition to one core carrying sheeted ~~rubber-coated~~ fabric with their threads at an angle, and another pair of stock-rolls mounted on the head for alternate juxtaposition on the other core also carrying sheeted ~~rubber coated~~ fabric with their threads at an angle, substantially as described.

per a

" "

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

(Sgd.) Will C. State

WITNESSES:

(Sgd.) R. M. Lemieux

" O. W. Myers

City of Akron, :
County of Summit, : SS:
State of Ohio :

WILL C. STATE, the above named petitioner, being duly sworn, deposes and says that he is a citizen of the United States and resident of Akron, Ohio, and that he verily believes himself to be the original, first and sole inventor of the improvement in "Pneumatic Tire-Shoe Manufacturing Machines", described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof, or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that no patent has been granted in any country foreign to the United States upon an application filed by him or his legal representatives or assigns more than twelve months prior to this application, and that no application for patent on said improvement has been filed by him or his representatives or assigns in any country foreign to the United States.

(Sgd.) Will C. State

Sworn to and subscribed before me this 22nd day of March,190

(Sgd.) Geo. W. Rogers

(SEAL.)

Div. 15 Room 308 AS Paper No. 2

DEPARTMENT OF THE INTERIOR,

UNITED STATES PATENT OFFICE,

WASHINGTON, D. C., June 15, 1909.

Will C. State,

c/o Gustav Bissing,

38 Park Row,

New York City.

U. S. Patent Office
Jun 15 1909
Mailed
Division 15

Please find below a communication from the EXAMINER in charge of your application,

for PNEUMATIC TIRE-SHOE MANUFACTURING MACHINE, filed Mar.26,1909, #486,043.

E. B. Moore,
Commissioner of Patents.

This case has been examined.

The lugs 13 and locking member 14, top of page 5, should be identified on the drawing.

The sign 28, line 21, page 5, should be -26-.

The sign 361, line 4, page 6, cannot be found.

The fact that the stock rolls in claim 1 (and elsewhere) carry strips of certain character is immaterial to the machine structure recited therein.

Claims 1, 2 and 3 are accordingly rejected.

Claims 4, 5, 6, 7, 8, 9, 10, 19, 23, 24 and 25 are rejected upon Bayne and Subers, #847,041, Mar.12,1907 (154 - App. T & T.)

Claims 11, 12, 13 and 14 seem to be allowable.

Claims 15 and 16 are rejected upon

Sloper, #852,855, May 7,1907 (154 App. T & T).

Claims 17 and 18 are rejected upon Bayne and Subers in view of an ordinary form of stretching device exemplified in

Scott, #741,381, Oct. 13,1903 (Leather Digest).

Claims 20 and 21 are rejected upon Sloper. Whether or not the tension roll is covered with vulcanized rubber seems immaterial in view of the well known use of such rolls. It is a question of selecting a suitable material merely. (Sgd.) Chas.C.Stauffer Exr

8303

EXAMINER STAUFFER.
DIVISION 15:
ROOM 308.

Serial No 486.043 Paper No. 3/a

Mail Room Aug 23 1909 U.S. Patent Office

IN THE UNITED STATES PATENT OFFICE.

THE COMMISSIONER OF PATENTS;

Sir:-

In the matter of the application of WILL C. STATE, filed March 26th, 1909, Serial No. 486,043, for "Pneumatic Tire-Shoe Manufacturing Machine", please amend as follows.

In fig. 2, to the right of the numeral 8, to the left of the numeral 38, and above the numeral 3, apply the numeral "13" to the pair of lugs and the numeral "14" to the locking member immediately therebelow.

Change the sign 28, line 21, page 5, to "26".

We shall have the numeral 361 applied to the drawing.

On page 1, line 14, after "open bellied or open tire-shoes" insert "in so far as they have been made direct from sheeted fabric".

On page 1, line 17, after "purpose" insert "of building tire-shoes from superposed layers of sheeted fabric in contradistinction to weaving the tires from threads which are woven or laid one after the other on the ring-core or former".

a'

On page 5, line 11, after "stock-roll" insert "which constitutes my sheet-fabric supply".

In claim 1, line 3; claim 2, line 3; and claim 3, line 3, before "carrying" insert "for".

In claim 4, line 2; claim 5, line 2; claim 6, line 2; claim 7, line 2; claim 8, line 2; claim 9, line 2; and claim 10, line 2, after "combination of" insert "a sheet-fabric supply,".

In claim 1, line 3; claim 2, line 4; claim 3, lines 3 and 4; claim 11, line 3; claim 12, line 3; claim 13, line 3; claim 14, lines 2 and 3; claim 19, line 5; claim 21, line 3; claim 22, line 5; claim 23, line 5; claim 25 (really24), lines 4 and 7, cancel "rubber-coated" and insert "sheeted".

Cancel claims 17 and 18 and insert the following:

17. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of fabric, a tension roll, a power-driven ring-core for drawing the fabric under tension from the stock-roll, and a stretching-roll provided with divergent, spirally arranged sets of grooves between the tension roll and the ring-core, whereby the longitudinal creases are taken out of the fabric in its passage to the ring-core, substantially as described.

a2

18. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of fabric, a tension device, a power-driven ring-core for drawing the fabric under tension from the stock-roll, and a stretching-roll between the tension device and ring-core, whereby the longitudinal creases are taken out of the fabric and it is smoothly and evenly applied to the ring-core, substantially as described.

Cancel claim 20 and renumber the remaining four claims as 20, 21, 22 and 23.

ARGUMENT.

THE REJECTION ON BAYNE et al AND SLOPER.

The State machine builds tire-shoes from superposed **sheets** of fabric. The machine starts with sheets. These sheets are bought in the open market. How they are woven from their threads does not concern State. The Bayne and Sloper apparatuses, as the Examiner will see at once by look-

ing at Fig. 1 of Sloper or fig. 5 of Bayne, or by reading page 1, lines 9 to 18, of Sloper or page 1, lines 23 to 35 of Bayne, build tire-shoes from separate threads or cords. They are weaving machines. They might be described as machines for knitting the threads which ultimately make up the tire on the former or ring-core.

We understand machines of the Bayne and Sloper type have actually been used in England. But, however this may be, it is of no consequence for present purposes. Whether the tire weaving machines of the references are successful or unsuccessful, good or bad, commercially existent or non-existent, they are an utterly different type of apparatus from that at bar, which might be described as a device for pasting and forming layers of sheeted fabric into tires on ring-cores.

The State apparatus is, as the specification asserts, the first of its type which has come into commercial use, and use on a large scale too; but it belongs for all that to an old type of machine, as see, for instance, the patents to Vincent No. 794473 and No. 906588, where the design is also to make open bellied tires from superposed sheets of fabric pasted together. But these Vincent machines although they have been tried have not continued in use. The dofferences which the machine of this application shows over Vincent have turned a commercial failure into success.

To still further develop the generic differences which exist between State and all machines of the weaving type like those of Bayne and Sloper, we have amended the specification on page 1, lines 14 to 18, and have put as an element into each claim a sheeted fabric supply, either generically as in claims 4 to 10 or else specifically as in the claims mentioning the stock-roller for carrying sheeted

fabric. This state of facts, now emphasized by our amendments, will, we believe, result in withdrawing the Bayne and Sloper citations and any similar thereto.

Besides, it needs but little critical comparison of the State apparatus with those of the citations to see at once that these cannot have or utilize spinning-rolls, or forming rolls, or stock-rolls for carrying a strip of rubber-coated fabric or any other of the elements of the claims excepting only the ring-core. This element is common to the two structures as it is common to a number of other structures in the present and allied arts. But State is only claiming this ring-core in combination with elements not in the references to constitute structures which perform operations of which the citations are incapable. We have then to ask for an allowance of claims 4, 5, 6, 7, 8, 9, 10, 15, 16, 19, 23, 24 and 25.

REJECTION OF CLAIMS 1, 2 and 3.

The Examiner correctly says that fact that the stock-rolls carry strips of certain character is immaterial to the machine structure recited therein. We have therefore reshaped the claims so that the strips of fabric are no longer elements of the claims and thus met the Examiner's objection. At the same time we beg to note that claim 1 raises a peculiar question and one which out ultimate antagonists in Court will insist we have solved erroneously no matter which way the decision falls. Against this claim 1, as now drawn, the defending expert will argue, as it needs no prophet to tell us, as follows: "It is, as drawn, for a mere duplication of stock rolls and since the applicant has not positively included the real inventive idea, namely the strips of fabric having their threads at an angle for alternate application to the core to make a built-up tire

hacing threads of adjacent fabric at an angle, he has not covered his real invention and his claim being, as drawn, for a mere duplication is void." Of course, had we left claim 1 in its original shape he would have argued that the fabric is not a proper element of a machine claim, citing authorities, and would have insisted that therefore claim 1 was void. Since, on the whole, it is immaterial to us which of these two positions we shall be called upon to meet, we have accepted and adopted the Examiner's requirement. All we insist upon is that, however expressed, the broad idea of combining two stock rolls for carrying fabric with threads related in a peculiar way to supply threads of proper angle to the ring-core involves invention and a fortiori ~~is~~ invention involved in the pair of stock rolls on a transversely movable rotary support for carrying such fabric.

THE REJECTION OF CLAIMS 17 AND 18.

The form of stretching-roll may be old. But it is used, in the State apparatus, in a new combination to effect a useful purpose. The power-driven ring-core draws the fabric, under tension, from the stock-roll. This, as State discovered and as no one before him had discovered, formed troublesome creases in the fabric between the tension device and the ring-core. Having found the difficulty he tried half a dozen remedies, without success, until he hit upon the present device of inserting a stretching-roll between the driven-core and the tension device. That solved the problem. The fact that we are dealing with what is, in a commercial sense at least, a new type of machine is a strong argument for finding invention in the application of an old element to its combinations to effect a useful purpose. The fact that State tried a number of devices before hitting

upon the successful one is another argument for patentability. Finally we beg to note that the Examiner will find that this State machine is very near the bottom of the art. He will find extremely few samples of machines showing ring-cores and stock-rolls and only a single specimen that shows as well a tension device. In this elementary state of the art, it may be safely assumed that it involves invention to put the double spiral stretching-roll between the ring-core and the tension device to get rid of the creases which have been found to form there. State has a peculiar combination and a peculiar difficulty and the addition of an element to this combination to overcome the difficulty makes a new combination even of the added element considering *per se* is old.

THE REJECTION OF CLAIMS 20 AND 21.

We have cancelled claim 20 which specifies the rubber-coating of the tension-roll. But claim 21 does not embrace this feature and recites a combination of elements which are certainly not found in the thread weaving machine of Bayne and Sloper.

An allowance is requested.

Respectfully submitted,

(Sgd.) Gustav Bissing

Attorney for State.

New York, Aug. 20, 1909.

Div. 15 Room 308 AS Paper No. 4

DEPARTMENT OF THE INTERIOR,

UNITED STATES PATENT OFFICE,

WASHINGTON, D. C., Oct. 12, 1909.

Willm C. State,

c/o Gustav Bissing,

38 Park Row,

New York City.

U. S. Patent Office
Oct 12, 1909
mailed
Division 15

Please find below a communication from the EXAMINER in charge of your application,

for PNEUMATIC TIRE-SHOE MANUFACTURING MACHINE, filed Mar. 26, 1909, #486,043.

E. B. Moore,
Commissioner of Patents.

This case considered as amended Aug. 23, 1909.

The line X is not found on Fig/ 4.

The line Y is not found on Fig. 3.

The rotary head 8 seems to be mounted upon cylinder 3 upon the drawings, instead of directly upon the base 1 as described.

Reference characters 13, 14 and 361 have not been placed upon the drawings.

Reference numeral 59 should be primed, page 6, line 2 from the bottom and where it designates the lever at the right of Fig. 5.

The lead line from 62 on Fig. 1 does not terminate at a bolt.

On Fig. 3 "74" and "34" are applied to shaft 70.

Reference numeral 82 appears to be applied to a spoke of sprocket wheel 81, which wheel is not described. It is not stated how shaft 78 is driven.

On Figs. 5 the lead line should be extended from reference numeral 90 to the shaft designated.

Probably "82" on Fig. 1 should be -83-.

Reference numeral 134 is not found on the drawings.

Page 14, line 5, "157" should be -156-. Line 16, pressing

is misspelled.

Page 17, line 5 from the bottom,"121 and" should be canceled.

Claims 1 to 3, 19, 22 and 23 are rejected upon

Vincent, #794,473, July 11, 1905 (154 - T & T) and

British patent #20,440 of 1904 (101- Feeding Web).

Claims 4 to 10 are rejected upon Bayne et al, of record, Vincent, cited, and

Vincent, #906,588, Dec. 15, 1908 (154 - T & T).

Claim 15 is rejected upon Vinvent, #794,473,

Pierce, #832,207, Oct. 2, 1906 (154 - Lin.) and

Jaeger, #410,521, Sep. 3, 1889 (101 - 36).

New claims 17 and 18 are rejected upon the Vincent patents cited and Scott of record.

(Sgd.) Chas. C. Stauffer

Examiner.

(Sgd.) L

Room 308. 8309 367

Serial No. Paper No 5

B

IN THE UNITED STATES PATENT OFFICE.

THE COMMISSIONER OF PATENTS:

Application Room Oct 29 1909 U.S. Patent Office

Sir:-

In the aplication of Will C. State, Serial Number 486,043, filed March 26, 1909, for "Pneumatic Tire-Shoe Manufacturing Machine", please amend as follows:

On page 2, line 9, after "rolls" insert,- "by radial motion with respect to the ring-core".

On page 2, line 12, before "spring-pressed" insert "preferably".

On page 2, line 22, after "tire-shoe" insert "by radial motion with reference to the ring-core"..

On page 3, lines 1 and 2, cancel "preferably".

On page 3, second line from bottom, cancel "on line X of fig. 4".

On page 4, line 1, cancel "on line Y thereof".

On page 4, three lines from bott om, after "member" insert "3".

On page 7, lines 17, 18, cancel "in such a manner that when they" and insert, "at alternate angles which means that when the stock-rolls".

On page 13, last line but one, before "support" insert,- "and in this case sliding".

On page14, line 1, after "ring-core" insert,- "that is radially with respect to the ring-core".

On page 14, line 2, change "canvas" to "sheeted fabric".

On page 14, line 5, change "157" to "156".

On page 14, line 16, change "pressind" to "pressing".

On page 14, last line but one, before "spring" insert "shown as".

On page 15, line 5, after "tool" insert "or a hand-pressed roll".

On page 15, lines 7, 8, cancel "hand-operated roll" and insert,-

"roll pressed against the core by hand".

On page 15, line 9, after "springs" insert,- "and as an equivalent therefor".

On page 15, line 11, after "ring-core" insert,-

B'

"When then I say the spin ing-rolls or their supports are laterally spring-pressed, I mean either spring or weight pressed laterally against the ring-core for, as before stated, a spring is the equivalent of a weight. In a broader aspect of my invention, however, I may employ mechanical instrumentalities, not the hands of the operator, other than springs or weights for pressing the spinning-rolls laterally against the ring-core. I shall, then, use the term "power-pressed" to cover generally not only springs and weights but other mechanical instrumentalities for pressing the spinning-rolls against the ring-core. When I refer to my spinning-rolls as laterally yielding and no more, I means to include any source of power for pressing the spinning-rolls against the ring-core, even the comparatively inefficient and irregular power contained in the hands of the operator.

On page 18, last line, change "four or five" to "seven or eight".

Cancel the claims and insert,-

B²

1. An open tire-shoe making machine comprising the combination of a power-driven ring-core, and a pair of stock-rolls for carrying strips of sheeted fabric having their threads at alternate angles for alternate application

to the core, substantially as described.

2. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a transversely movable support, and a pair of stock-rolls for carrying strips of sheeted fabric having their threads at alternate angles mounted on the support for alternate juxtaposition to the ring-core, substantially as described.

3. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a rotary support, and a pair of stock-rolls for carrying strips of sheeted fabric having their threads at alternate angles, mounted on the support for alternate juxtaposition to the core, substantially as described.

4. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally spring-pressed toward the core, and a spinning-roll mounted on the support for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

5. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally spring-pressed toward the core, and a spinning-roll mounted on the support at a receding angle to the plane of the core for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

6. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally spring-pressed toward the core, and a spinning-roll having a rounded disc-shaped working edge mounted on the support for passing radially along the sides of the tire-shoe to shape the sheeted

fabric on the core, substantially as described.

7. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally spring-pressed toward the core, and a spinning-roll having a rounded disc-shaped working edge mounted on the support at a receding angle to the plane of the core for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

8. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially movable tread-forming-roll for shaping the outer portion of the tire, a radially moving support laterally spring-pressed against the core, and a spinning-roll mounted on the support to pass radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

9. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core and a transversely and radially movable support carrying both a tread-forming-roll for shaping the outer portion of the tire and a laterally yielding spinning-roll for passing radially over the sides of the tire-shoe to shape the sheeted fabric on the core, which rolls are alternately juxtaposed to the ring-core, substantially as described.

10. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, and a radially movable, rotary support carrying a tread-forming-roll for shaping the outer portion of the tire-shoe and a laterally yielding spinning-roll for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

11. An open tire-shoe making machine comprising

the combination of a stock-roll for carrying a strip of sheet-fabric, a ring-core, a slow-speed mechanism for actuating the core when receiving fabric from the stock-roll, a forming-roll, a fast-speed mechanism for actuating the ring-core during the operation of the forming-roll, and speed-changing mechanism, substantially as described.

12. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of sheet-fabric, a ring-core, a slow-speed mechanism for actuating the core when receiving fabric from the stock-roll, a radially moving spinning-roll ~~laterally power pressed against the core~~ for passing radially over the side of the tire-shoe to shape the fabric on the core, fast-speed mechanism for actuating the ring-core during the operation of the spinning-roll, and speed-changing mechanism, substantially as described.

13. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of sheet-fabric, a ring-core, a slow-speed mechanism for actuating the core when receiving fabric from the stock-roll, a radially moving support laterally power-pressed against the ring-core, a spinning-roll mounted on the support at a receding angle to the ring-core to pass over the side of the tire-shoe to shape the fabric on the core, a fast speed mechanism for actuating the ring-core during the operation of the spinning-roll, and speed-changing mechanism, substantially as described.

14. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of sheeted fabric, a ring-core, a slow-speed mechanism for actuat ing the core when receiving fabric from the stock-roll, a radially and transversely movable support, a tread-forming-roll and a laterally yielding spinning-roll for passing radially over the sides of the tire-shoe mounted thereon,

fast-speed mechanism for actuating the ring-core during the operation of the tread-forming and spinning-rolls, and speed-changing mechanism, substantially as described.

15. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a stock-roll for carrying a spiral winding of rubber-coated fabric and muslin, or the like, and a yieldingly mounted take-up roll frictionally engaging the material on the stock-roll, whereby the muslin is taken up as the rubber-coated fabric is drawn onto the ring-core, substantially as described.

16. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of sheeted fabric, a tension-roll, a power-driven ring-core for drawing the sheeted fabric under tension from the stock-roll, and a stretching-roll provided with divergent, spirally arranged sets of grooves between the tension roll and the ring-core, whereby the longitudinal creases are taken out of the fabric in its passage to the ring-core, substantially as described.

17. An open tire-shoe making machine comprising the combination of a stock-roll for carrying a strip of sheeted fabric, a tension device, a power-driven ring-core for drawing the fabric under tension from the stock-roll, and a stretching-roll between the tension device and ring-core, whereby the longitudinal creases are taken out of the fabric and it is smoothly and evenly applied to the ring-core, substantially as described.

18. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a movable head, and two sets of rolls for alternate juxtaposition to the core, each set comprising the stock-roll for carrying a strip of sheeted fabric having its threads at alternate angles, and a tension-roll over which the fabric passes on its way to the

core, substantially as described.

Cancelled per C.

19. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a stock-roll for carrying sheeted fabric, a tension-roll over and around which the fabric passes, and a stretching roll under which the fabric runs, substantially as described.

19 ~~20~~. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a movable head, and two sets of rolls for alternate juxtaposition to the core, each set comprising a stock-roll for carrying a strip of sheeted fabric having its threads at alternate angles, and a stretching-roll provided with divergent, spirally arranged sets of grooves over which the fabric passes on its way to the core, substantially as described.

20 ~~21~~. An open tire-shoe making machine comprising the combination of a power-driven ring-core, a movable head and two sets of rolls for alternate juxtaposition to the core, each set comprising a stock-roll for carrying a strip of sheeted fabric having its threads at alternate angles, a tension-roll and a stretching-roll over which the fabric passes on its way to the core, substantially as described.

21 ~~22~~. An open tire-shoe making machine comprising the combination of two power-driven ring-cores, a rotary head, a pair of stock-rolls mounted thereon for alternate juxtaposition to one core carrying sheeted fabric with their threads at alternate angles, and another pair of stock-rolls mounted on the head for alternate juxtaposition to the other core also carrying sheeted fabric with their threads at alternate angles, substantially as described.

22 ~~23~~. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally power-pressed

toward the core, and a spinning-roll mounted on the support for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

~~24.~~23 An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally power-pressed toward the core, and a spinning-roll mounted on the support at a receding angle to the plane of the core for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

~~25~~24 An open tire-shoe makingmachine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally power-pressed toward the ~~xxxx~~core, and a spinning-roll having a rounded disc-shaped working edge mounted on the support for passing radially along the sides of the tire-shoe to shape the sheeted fabric, on the core, substantially as described.

~~26~~25 An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally power-pressed toward the core, and a spinning-roll having a rounded disc-shaped working edge mounted on the support at a receding angle to the plane of the core for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described.

~~27~~26 An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core for drawing the sheet-fabric from the source of supply in a flat condition, a radially sliding support, and a laterally yielding spinning-roll on the support for passing radially along the sides of the ring-core to curve and shape the sheet-

ed fabric thereon, substantially as described.

Respectfully submitted,

(Sgd.) Gustav Bissing

Attorney for State.

New York, October 29, 1909.

8318

UNITED STATES PATENT OFFICE

County of Summit :
:
State of Ohio :

Will C. State, a citizen of the United States, residing at the corner of College and East Market Streets, Akron, Ohio, being duly sworn, deposes as follows:

I am applicant in Application #486043, filed March 26th, 1909, for Pneumatic Tire Shoe Manufacturing Machines.

As Mechanical Engineer of The Goodyear Tire & Rubber Company, I am necessarily familiar with the art of making Tire Shoes for Pneumatic Tires, especially from multiple plies or layers superposed on each other; this being the present practice.

I believe that the Machine described in this Application is the first which has ever been commercially used for making such Tire Shoes, and that heretofore such multiple layer Pneumatic Tire Shoes have been entirely made by hand.

I am informed and believe that a Machine about as shown in the Vincent Patent #794473, and employing hammers for shaping the tire fabric on the sides of the ring core, has been used in this country, but that it proved unsatisfactory and was abandoned.

From an actual first-hand knowledge of the facts, I have found that an operator can readily make over forty tires a day on my Machine; whereas, by hand, he has heretofore been able finish about seven or eight tires , to

the extent to which they are finished on the Machine.

In the course of developing my Machine, the fabric as it was drawn from the supply rolls on to the ring core, would fall into creases. This was, in part, due to the fact that the fabric comes off the supply roll in a flat state, and is pulled from the high or peripheral part of the ring core into a curved or bowed condition. To obviate this defect, I first used a roll about as broad as the fabric and slightly bowed in the center, thinking in this way to support the material in a curved condition, and thus to remove the creases. This plan proved unsuccessful. I thereupon used a very sharp oval roll, to give a considerable curve, transversely considered, to the fabric. This again was unsuccessful. I then used the stretching rolls shown in my application, but had to try them in several positions with relation to the fabric, above and below, before the satisfactory arrangement now shown in my application was reached.

(Sgd.) Will C. State

Sworn to and subscribed before me this 22nd day of October, ninteen hundred nine.

(Sgd.) Geo. W. Rogers

Notary Public.

(SEAL.)

THE UNITED STATES PATENT OFFICE.

County of Summit :
:
State of Ohio :

Frank A. Seiberling, being duly sworn, deposes as follows:

I am a resident of Akron, Ohio, and President of The Goodyear Tire & Rubber Company of that place. I am entirely familiar with the Tire Shoe Making Machine desctibed in the State Application #486043 filed March 26th, 1909.

As President of The Goodyear Tire & Rubber Company, it has been my business to keep informed on the art of making Pneumatic Tire Shoes, and I have kept myself so informed by discussing the state of the art with the various competitors of The Goodyear Company, by visiting other factories where Tire Shoes are made, and by reading the trade journals.

I believe that before the State invention multiple layer Pneumatic Tire Shoes which are built up from successive superposed layers of fabric have been practically exclusively made by hand, and that the State Machine is the first to successfully make such Tires on a commercial scale by machinery.

A machine-made Tire, by reason of greater evenness of manufacture, is also a better Tire that those heretofore made by hand. As a consequence, the State Machine has been

introduced into the factory of The Goodyear Tire & Rubber Company, and is turning out a large number of Tires each day, which are being sold and used in the regular way.

A number of these Tire-Making Machines have also been built and are building and are being leased under royalty to the principal tire manufacturers in the country, such as the Hartford Rubber Works Company of Hartford, Ct., Morgan & Wright Company of Detroit, Mch., and the Fisk Rubber Company of Chicopee Falls, Mass.

As a result of actual test, it has been ascertained that a man with the State Machine can produce at least five times as many Tires in a day as under the old hand process.

Affiant has, furthermore, been informed from several responsible sources, and believes that a machine like that of the Vincent Patent #794473, employing a set of hammers to shape the fabric on the sides of the ring-core, has been actually tried in one of the large tire-making factories in this country, but that it was unsuccessful and that its use has been abandoned.

(Sgd.) Frank A. Seiberling

Sworn to and subscribed before me this 22nd day of October, ninteen hundred nine.

(Sgd.) Geo. W. Rogers

(SEAL.) Notary Public

6/6

Application Room
Oct 30 1909
U.S. Patent Office

IN THE UNITED STATES PATENT OFFICE.

THE COMMISSIONER OF PATENTS:

Sir:

6 In the application of Will C. State, Serial No. 486,043, filed March 26, 1909, for "Pneumatic Tire-Shoe Manufacturing Machine", please amend as follows:

Cancel claim 19 and renumber.

(Sgd.) Gustav Bissing

Atty.

J. H. Serial No. 486,043.

DEPARTMENT OF THE INTERIOR,

UNITED STATES PATENT OFFICE,

WASHINGTON, D. C., Nov. 5, 1909.

Will C. State, Assor.,

c/o Gustav Bissing,

38 Park Row,

New York, N.Y.

Sir: Your APPLICATION for a patent for an IMPROVEMENT in Pneumatic Tire-Shoe Manufacturing Machine, filed Mar. 26, 1909, has been examined and ALLOWED.

(Balance of Official Notice of Allowance.)

Defendant's Exhibit Z.

Drawing showing limit of inward motion of rolls 30.

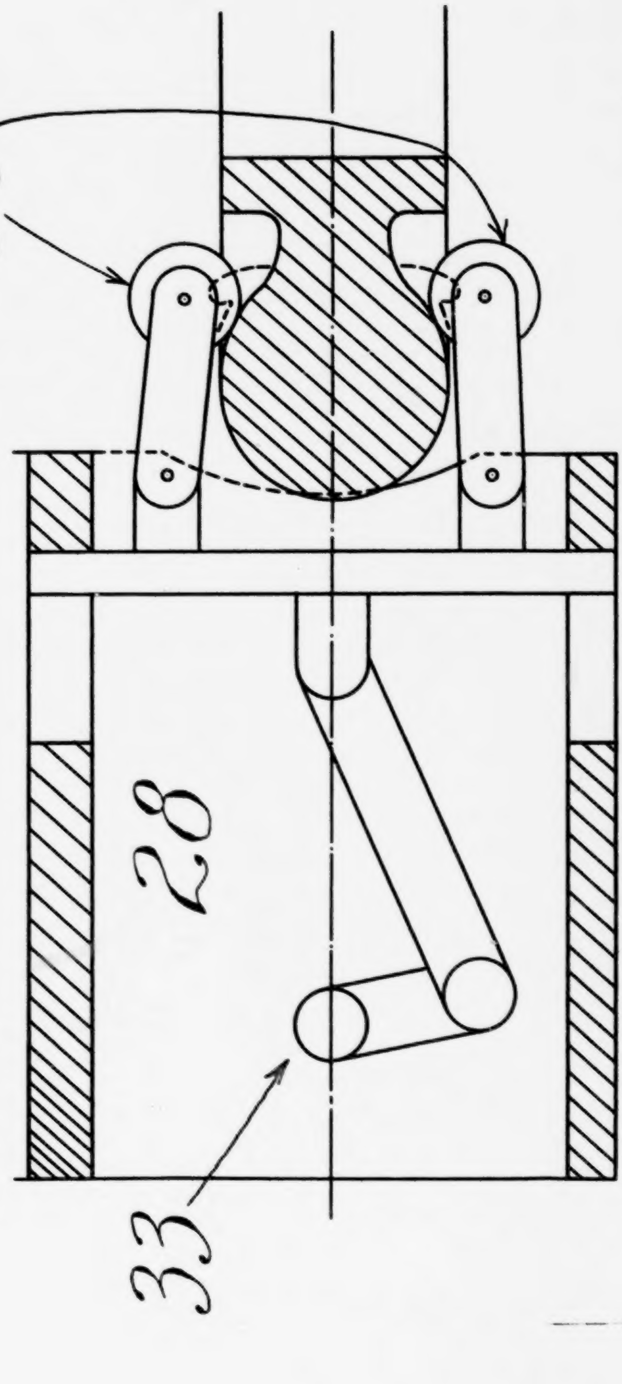

Fig. 4. (Ray.)

In the United States District Court for the District of New Jersey.

In Equity. No. 614.

[Title omitted.]

Rog[illegible] Campbell, Esqs., for complainant.
E. Cla[illegible]sq., and Thos. G. Haight, Esq., for defendant.

Opinion.

[Filed February 14, 1922.]

Bodine, *District Judge:* This case involves letters patent 941,-962 for a tire making machine, granted November 30, 1907, upon the application of Will G. State, his interest assigned to the plaintiff. The bill also claims an infringement of patent 762,561 granted on the application of Messrs. Seiberling and Stevens. This patent has been withdrawn and a decree is asked under the State patent alone.

The plaintiff's patent was before the Circuit Court of Appeals for the Sixth Circuit in the case of Firestone Tire and Rubber Company v. Seiberling, 257 Fed. Reporter 74. The claim is urged, however, that the record in the present case is so distinct from the record in that case that a different result is inevitable, the distinction being that a disclaimer having been filed February 14, 1919, claims 1, 2, 3, 18, 19, 20 and 21 are not in suit and claims 8, 9, 10, 11, 14, 15, 16 and 17 have been erased. The effect of the disclaimer is broadly to limit the patent to a combination in a tire making machine of a forming or spinning roll with a high speed core. The method or process used is the same which the proofs showed had for many years prior to the patent been used in the making of tires by hand.

The Circuit Court of Appeals for the Sixth Circuit considered the case as though before them in its present aspect. See page 82. If further authority is necessary see Conroy v. Penn Electrical & Manufacturing Company, 115 Fed. 421, affirmed 159 Fed. 943. The result reached makes it unnecessary to pursue the many other grounds urged for the invalidity of the patent.

The relief sought will be denied.

In the United States District Court for the District of New Jersey.

In Equity. No. 614.

[Title omitted.]

Final Decree.

[Filed February 21, 1922.]

This cause came on to be heard at the September, 1921, term, and was argued by counsel on December 13 and 14, 1921, and thereupon, upon consideration thereof, it is

Ordered, adjudged and decreed that the bill of complaint herein be, and the same hereby is, dismissed, with costs to the defendant to be taxed. J. L. Bodine, United States District Judge. February 21, 1922.

Form approved. Rogers, Kennedy & Campbell, Solicitors for Plaintiff.

In the District Court of the United States for the District of New Jersey.

In Equity. No. 614.

[Title omitted.]

Assignment of Errors.

[Filed March 2, 1922.]

In pursuance of and obedient to the rules and practice of the United States Circuit Court of Appeals for the Third Circuit, in such cases made and provided, the above-named plaintiff respectfully makes the following assignment of errors in the above entitled cause, to wit:

1. The Court erred in dismissing and not in sustaining the bill of complaint herein.

2. The Court erred in failing to award a decree for plaintiff in accordance with the bill of complaint.

3. The Court erred in failing to hold that claims 4, 5, 6, 7, 12, 13, 22, 23, 24, 25 and 26 of the State Patent No. 941,962 in suit, are valid and infringed by defendant's machine.

4. The Court erred in basing its decision on that of the Circuit Court of Appeals for the Sixth Circuit, and in failing to find that the present record is materially different from that before the said Circuit Court of Appeals, and in not rendering an independent decision upon the different state of facts herein.

5. The Court erred in refusing to grant the relief sought in the bill of complaint.

6. The Court erred in not awarding an injunction against defendant.

7. The Court erred in not decreeing an accounting of profits and damages for defendant's infringement.

Wherefore the said plaintiff, Frank A. Seiberling, prays that the decree of the said District Court of the United States for the District of New Jersey be reversed, and that the said District Court of the United States for the District of New Jersey be directed to enter a decree for said plaintiff in conformity with the prayer of his bill of complaint. Frank A. Seiberling, By Rogers, Kennedy & Campbell, Solicitors and of Counsel for Plaintiff.

In the District Court of the United States for the District of New Jersey.

In Equity. No. 614.

[Title omitted.]

Petition for Appeal.

[Filed March 2, 1922.]

The above-named plaintiff, conceiving itself aggrieved by the decree made and entered in the above-entitled cause and filed in the office of the clerk of this court, in the City of Trenton, in the District of New Jersey, on the twenty-first day of February, 1922, hereby appeals therefrom to the United States Circuit Court of Appeals for the Third Circuit, for the reasons specified in the assignment of errors, and prays that its appeal may be allowed, and that a citation may be directed to the above named defendant, The John E. Thropp's Sons Company, commanding it to appear before the United States Circuit Court of Appeals for the Third Circuit, to do and receive what may appertain to justice to be done in the premises; and that a transcript of the record, proceedings, evidence and opinion in said cause, duly authenticated, may be sent to the United States Circuit Court of Appeals for the Third Circuit; and that the said decree of the United States District Court for the District of New Jersey herein may be reversed, and such decree made as to the said United States Circuit Court of Appeals for the Third Circuit, may seem meet and just.

And your petitioner further prays that the proper order touching the security to be required of him to permit his appeal be made. Frank A. Seiberling, By Rogers, Kennedy & Campbell, Solicitors and of Counsel for Plaintiff.

Order Allowing Appeal and Fixing Bond.

[Filed March 2, 1922.]

And now, to wit, this second day of March, 1922, upon consideration of the foregoing petition, it is ordered by the Court that the appeal prayed for therein be, and the same is hereby allowed, and the amount of the appeal bond to be entered by the petitioner is hereby fixed at the sum of two hundred and fifty dollars ($250). J. L. Bodine, U. S. Judge.

Citation and Service.

[Filed April 14, 1922.]

By the Honorable Joseph L. Bodine, Judge of the District Court of the United States for the District of New Jersey, to the John E. Thropp's Sons Company:

Whereas, Frank A. Seiberling, has lately appealed to the United States Circuit Court of Appeals for the Third Circuit, from final decree lately rendered in the District Court of the United States, for the District of New Jersey, made in favor of you, the said The John E. Thropp's Sons Company, and has filed the security required by law; you are, therefore, hereby cited to appear before the said United States Circuit Court of Appeals, for the Third Circuit, to be held at the city of Philadelphia, in the State of Pennsylvania, on the twenty-ninth day of April next, to do and receive what may appertain to justice to be done in the premises.

Given under my hand, at the City of Trenton, in the District of New Jersey, in the Third Circuit, the thirtieth day of March, in the year of our Lord one thousand nine hundred and twenty-two. J. L. Bodine, Judge.

Service of a copy of the within citation acknowledged this first day of pril, 1922. E. H. W. Seward, Solicitor for Defendant.

In the United States Circuit Court of Appeals for the Third Circuit, March Term, 1922.

No. 2862 (List No. 55).

[Title omitted.]

Argument and Submission.

And afterwards, to wit, on the 9th & 10th days of May, 1922, come the parties aforesaid by their counsel aforesaid, and this case being called for argument sur pleadings and briefs, before the Hon-

orable Joseph Buffington, Honorable Victor B. Woolley and Honorable J. Warren Davis, Circuit Judges, and the Court not being fully advised in the premises, takes further time for the consideration thereof,

And afterwards, to wit, on the 19th day of October, 1922, come the parties aforesaid by their counsel aforesaid, and the Court, now being fully advised in the premises, renders the following decision:

In the United States Circuit Court of Appeals, Third Circuit, October Term, 1922.

No. 2862.

[Title omitted.]

Opinion.

[Filed Oct. 19, 1922.]

Appeal from the District Court of the United States for the District of New Jersey.

Before Buffington, Woolley, and Davis, Circuit Judges.

Buffington, *C. J.*: In the Court below, suit was brought by the owner of Patent No. 941,962, granted November 30, 1909, to Will C. State, for a pneumatic tire-shoe manufacturing machine. The suit charged infringement by the John E. Thropp Company of Claims 4, 5, 6, 7, 12, 13 and 22 to 26 inclusive.

As shown in its opinion printed in the margin* the Court below conceived the case was substantially the same as that decided by the Circuit Court of Appeals of the Sixth Circuit, reported at 257 Fed.

*"This case involves letters patent 941,962 for a tire making machine, granted November 30, 1909, upon the application of Will C. State, his interest assigned to the plaintiff. The bill also claims an infringement of patent 762,-561 granted on the application of Messrs. Seiberling and Stevens. This patent has been withdrawn and a decree is asked under the State patent alone.

The plaintiff's patent was before the Circuit Court of Appeals for the Sixth Circuit in the case of Firestone Tire and Rubber Company v. Seiberling, 257 Fed. Rep. 74. The claim is urged, however, that the record in the present case is so distinct from the record in that case that a different result is inevitable, the distinction being that a disclaimer having been filed February 14, 1919, claims 1, 2, 3, 18, 19, 20 and 21 are not in suit and claims 8, 9, 10, 11, 14, 15, 16 and 17 have been erased. The effect of the disclaimer is broadly to limit the patent to a combination in a tire making machine of a forming or spinning roll with a high speed core. The method or process used is the same which the proofs showed had for many years prior to the patent been used in the making of tires by hand.

The Circuit Court of Appeals for the Sixth Circuit considered the case as though before them in its present aspect. See page 82. If further authority is necessary see Conroy v. Penn Electrical & Manufacturing Company, 115 Fed. 421, affirmed 159 Fed. 943. The result reached makes it unnecessary to pursue the many other grounds urged for the invalidity of the patent. The relief sought will be denied."

Rep., and without itself entering into a discussion of the issues here involved, it in effect followed that case. As in our view the record presented in this case is substantially different from that before the Circuit Court of Appeals in the case cited, we are justified in placing of record a full statement of the issues here involved and our reasons for reversing the decree entered below.

The case is important. It concerns the machine-making of a pneumatic rubber shoe for an automobile tire, and a satisfactory tire is the measure of an automobile's efficiency. Such shoe is a built-up product, composed of successive layers of fabric cemented or plastered to each other. Leaving aside the tires made by a single stretch of fibrous material, and which were forced into place on the side of the shoe by what are known as "jigger fingers," and confining ourselves to shoes in which the material is stretched at different parts of the shoe in two directions at right angles to each other, and to a process of cementing or plastering them in place by a spinning roll, we note the fact that tires embodying these two features of double stretch and roll-spinning fastening, were, before the patent to State here in question, hand made.

A statement of the old, hand-made art is so clearly set forth by Judge Denison in the opinion in the Sixth Circuit case, we copy his words: "An annular metallic core having spokes and a hub was centrally mounted upon a shaft so that it could revolve, the core thus resembling the rim or tire of a wheel. This core was approximately circular in cross-section, and its cross-section diameter as well as its entire diameter through the hub from edge to edge of the rim were proportioned according to the size of the casing to be made. The operator coated this core with an adhesive substance. He then took a strip of rubber-impregnated fabric which would stretch out to be as long as the circumference of the core, and in width somewhat less than the circumference of the cross-section. As he revolved the core on its hub, he stretched and pasted this fabric strip upon the core, pressing and shaping it with his fingers or with hand tools so that it adhered in all places and was without wrinkles. He repeated this operation as many times as there were to be fabric layers in the casing. The impregnating composition, having the character of rubber, would also attach each two layers of the fabric together. The strip of fabric was cut upon the bias, and the warp threads therefore ran from the inner open edge of the tube in a diagonal course along, across and around the tube to the other open edge thereof; and the next layer of fabric put on was reversed so that these warp threads crossed those of the first layer at a selected angle. Where the ends of the fabric met each other, they were overlapped enough to make a pasted joint. Each layer of fabric was first pressed down and attached by the hand of the operator on its central portion throughout its length, thus constituting the part of the casing corresponding to the tread. The degree of lateral curvature here is slight, and there would be no difficulty in making a smooth attachment, but as it was continued around the remaining circumference of the cross-section, there would be an obvious tendency to gather and

wrinkle. This wrinkling would be fatal to the strength of the casing, and it could be avoided only by careful manipulation and gradual shaping. The ultimately smooth and unwrinkled surface could be had by virtue of a quality which all woven material has had since weaving was known; *i. e.* that it will contract in one direction, as it stretches in another, when a fabric is stretched in one diagonal direction, its square meshes become diamond-shaped, with the length of the diamond along the line of stretch and its width at right angles. This produces a contraction of the fabric in the line of its width. In tire building, it is primarily the central part of the strip which is thus stretched longitudinally as it is attached to the tread of the core, leaving the side portions or wings projecting and free. Upon the same principle, if these side portions are then stretched laterally, they will shrink longitudinally, and, if this stretching is done in progressive measure as the edges are approached, the longitudinal shrinking will be greatest at the edge. In this way, it results that the fabric may be shaped smoothly and without wrinkles to the entire side core surface." With this picture distinctly in mind, it will be seen that in making such a shoe we have to deal with a series of non-uniform circumferences, viz: the longest circumference length at the outer or tread periphery of the core; at the two sides of the core the circumference length will be smaller, and as the inner or bead edge of the core is reached we have a still smaller circumference length. It is therefore apparent that as there is a lessening of core circumference from the outer or tread circumference zone to the shorter zone of the side and the still shorter one at the bead edge, and as the unitary rectangular fibrous sheet to cover these zones is of uniform length, puckers or wrinkles in such fibrous material would necessarily be formed in these shorter circumferences unless in some way the rectangular fabric of uniform length was shortened as it was cemented on these lesser core circumference zones. When the tread or outer periphery covering sheet was circumferentially stretched from normal, of course, as explained by Judge Denison, its square meshes became diamond-shaped, with the diamond in the line of circumference stretch. If this stretch was gradually diminished until the side zone of the core was reached, the diamond of the covering would correspondingly recede into the square of the normal form, and we would then have the normal unpuckered length of the fibrous material automatically taken care of at that point, and if, as the inner or bead edge of the shoe was reached, the fibrous material was stretched at right angles to the core, then its squares would take the form of radially pointed diamonds, and that would necessarily contract the length of the rectangular material. In other words, there was an initial stretch of the fabric from its normal squares into circumferential diamond-shape interstices. That made the tread portion of the tire. There was a normal square of the material at the side of the shoe, and below that there was a radial stretch of the covering at the inner or bead edge of the shoe, which changed the square to a radial diamond shaped interstice and correspondingly lessened the normal length of

the fabric. As explained by Judge Denison, this was accomplished in the hand process by the operator, who "stretched and pasted this fabric strip upon the core, pressing and shaping it with his fingers or with hand tools so that it adhered in all places and was without wrinkles". But the avoidance or elimination of wrinkles became more difficult as the zone of smaller circumference length was reached, and in that respect he said, "Each layer of fabric was first pressed down and attached by the hand of the operator on the central portion throughout its length, thus constituting the part of the casing corresponding to the tread. The degree of lateral curvature here is slight and there would be no difficulty in making a smooth attachment, but as it was continued around the remaining circumference of the cross-section, there would be an obvious tendency to gather and wrinkle. This wrinkling would be fatal to the strength of the casing, and it could be avoided only by careful manipulation and gradual shaping." This hand work required high skill and was physically hard on the operator. The core had to be actuated by one hand and the spinning roll directed by the other. Where the different layers of fabric overlapped, the roll was apt to jump. The initial speed of the core could not be maintained unless one hand of the tire maker was employed in revolving it and if one hand was so employed its non-use on the spinning roll of course made the roll jumping trouble more acute. Moreover, the variation in speed caused corresponding variation in the regularity and uniformity of the interstices of the fibrous material, and the output was limited to the strength and skill of the operator. The evidence is that under the hand tool process the possible production was but a few tires per day, but as its double stretch was regarded as most effective in securing tire strength, it was nevertheless continued. Hence the effort to devise a way to manufacture tires by machine. This was first attempted in a machine of wholly different type from the one here in question. That machine was the invention of Seiberling and Stevens and was the leading subject-matter in the case in the Sixth Circuit. Seiberling and Stevens' plan was to use jigger fingers, but the proof is that their jigger finger machine was not commercially successful and was commercially scrapped. In this state of the art, in 1907 State undertook to adapt the other or hand roll method of making a double stretched tire to machinery. Certain elements entering into that problem were of course well known. The fact of the desirability of the initial circumferential stretch of the tread portion into circumferential diamonds, was in use; the lessening of stretch resulting in squares on the side of the shoe was a well known practice, as was also the radial stretch for the inner portion of the shoe, which turned the square of the fabric into a diamond shape at right angles with the diamonds of the initial or tread stretch. So also the use of a hand or spinning roll was well known, and the problem involved, as in most machine improvements, was to take these well understood and recognized processes which were done by hand and directed by skill, and do the same work by machinery. This problem State met, and for the first time successfully solved in a machine-made tire of the double stretch character indicated. The machine he produced

was at once recognized. It went into instant use. On such machines millions of tires have been built, and large numbers of companies have taken out licenses under the patent.

In determining the inventive character of State's work, the first question involved is whether the successful machine first disclosed by him was a mere mechanical aggregation of separate well known steps, or a co-operating combination. We note, first, that what we are here dealing with is a unitary product, namely, a completed, machine-made shoe tire for an automobile. We are not dealing with the making of the tread portion of a tire alone, and with its consequent necessary circumferential stretch and the formation of circumferential diamond shaped interstices in the fabric in such tread portion. We are not dealing with the making of the median zone of the shoe, with the interstices square and unstretched. Nor are we dealing with the making of a bead zone where the stretch is radial and the interstices are radially pointed diamond shaped. But we are concerned with the machine-making of a finished tire in which there is a continuity of sustained, inter-related and necessary co-operation, in which there is a progressive length non-uniformity and an angle change of stretch, in which there is a change of speed rotation at different stages, and in which every one of the separate operations of the machine is individually essential to the completion of the unitary product of the unitary machine. Analyzing such machine, we note that in the tread circumference there is a low speed, and we there start with a circumferential stretch and a circumferential diamond-shaped interstice. Its separate processes and their product do not end and are not completed at any given point, but as each distinct process and mode of operation begins and carries on it correspondingly modifies the product, and as the machine functions in its entirety, there is a gradual and progressive change in the continuous operation and in the progressing and changing product, which gradually, uniformly, evenly and continuously changes the product of the machine from the initial circumferential stretch and the circumferential headed diamond-shaped interstices into a gradual approach to the normal square with its substantially unstretched fabric into which the product gradually shapes itself up to the side or median line. But the process does not stop here, for there is still a continual shading, this time from the square of the median zone of the tire side into the radial circumferential stretch of the bead or inner portion of the tire, and a gradual departure from the unstretched square of the median line to the radially stretched and radially pointed diamond shaped interstices of the bead or inner portion. Far from being separated, isolated zone processes, there is a gradual and uniform, and indeed an unbroken spiral sequence caused by the rapid rotation of the core and the consequent exercise of centrifugal force on the covering material, by which it is automatically gradually stretched radially and by the joint action of such centrifugal, radial stretch, and the spinning rolls, the square of the median zone progressively shades into the radial diamond shaped interstices of the bead or inner zone of the shoe. In a way we

have anticipated what State's machine really is, by thus describing its results. But such statement should be initially made, for the crux and dominating functional feature of State's machine is the use upon the fabric of a centrifugal force caused by rapid rotation, a process which is wholly different from the original hand process, and one which State in the experiments which he carried along in the development of his machine, first found he could utilize. Briefly stated, his machine may be thus described: He took the old core wheel of the hand process, and used impregnated strips of fabric and formed the outer or tread portion of the shoe and cemented it to the core, just as had been done in the old hand process. He continued that process just as it had been in the hand process, down to the point where he plastered or cemented the fabric on to the core down to the median line point. But here he changed to something the old hand process had never used, namely, the machine was speeded up to a point where the revolution of the wheel and flying skirt of the uncemented loose fabric stretched itself radially and formed thereby radial, diamond-shaped interstices, which contracted the normal length of the fabric. At this point we note that State made use of a shifting platform, on which he mounted on each side of the tire spinning wheels or rolls so pressed inwardly by springs that as the rolls revolved they engaged and pushed inward and against the sides of the core the stretched flying skirts of the fabric. Thereby he then, and by the wheels, pressed and cemented the radially stretched and therefore puckerless fabric against the lessening sides of the shoe clear down to the bead edge. It will therefore be seen that the essence of his disclosure was the rapid, sustained, regular revolution of his core, the use of a shifting platform on which he located his spinning rolls, and the constant, regular and uniform exertion of pressure upon those spinning rolls, causing them to automatically press the automatically stretched and loose fabric, or skirts, in an unwrinkled state, on the bead of the lower surface of the core. If this statement of the process be correct, and there can be no doubt in that regard, it follows that the process is a unitary one, is a continuous one, is an inter-related one, is an undivided one, and that there is a continuity of uniform, sustained, progressive, advance from the start to the finish of this machine-made tire, which is brought about by the rapid revolution of the core wheel acted upon by the spin of spring-controlled engaging rolls co-operating with the centrifugal force generated by the rapid motion of the core. In other words, united, co-operating, conjoint functioning of the core speed and spinning rolls, effected by roll springs and the shift of roll platform, all conjointly functioning to produce a unitary machine result which neither of them separately could effect. Such being the mechanical fact, who shall combat the patent deduction that these elements brought together and assembled for the first time by State, stamp the combination as an inventive combination and not as a mere mechanical aggregation of disjointed steps. At no single stage of this machine's processes do we find a complete, separate, finished entity. Standing alone, the tread with its circumferential diamond shaped interstices is nothing; the median or square por-

tion with its normal square, is nothing; the bead with its radial stretch and diamond pointed interstices is nothing. It is when each co-operating element in combination with its fellows has done its individual but still co-operating work, we produce the unitary and finished product which State for the first time made by machinery and which made such a great change in the tire art. Each element acts and has to co-act with its fellows to product the unitary result and make the unitary product which alone the machine was fashioned and devised to produce. And not only is this conclusion the inevitable sequence of a clear understanding of the process, but the question of aggregation and combination is strikingly solved, and practically answered by a study of the evolutionary processes or stages by which through some fifteen different steps the patentee gradually evolved in the tire-building art, the successful co-relation and adaptation of well-known hand operations to machine operations. The problem was one of great difficulty. It was not solved even by a single inventive thought or by its initial conception, but with the settled purpose in view of substituting machinery for hand work and automatic machine control for human skill. State went through a most unusual series of experiments, and as each one was made it disclosed some difficulty which he had to overcome and did overcome step by step until at last he evolved a structure which did by rapid machine work, and largely by automatic operation, what was previously solely and laboriously done by exhaustive hand work. That the result was novel, is established by proof. That it was useful is shown by its prompt and general adoption as well as by the vast aggregate of its product, and that it was inventive is demonstrated not only by its own facts but it is evidenced by the cases decided by many different judges in this industrial circuit, who have from time to time carefully followed a clear controlling principle in dealing with the question of aggregation or combination in machines. That general principle is that the earmark of combination is the co-acting of the elements to produce a unitary result. In the early case of The Societe v. Rehfuss, 75 Fed. Rep. 657, Judge Acheson, in considering a machine where during the continuous process operation of a pearl button cutting lathe, a sharpening wheel was brought into relation to the cutting tool, said:

"The several constituents co-operate in respect to the work to be done, each is essential to the complete organization, and the result is both new and highly useful."

The Court was there dealing with pearl, a substance so hard that its cutting tool had to be sharpened, or, as Judge Acheson said,

"the extreme hardness of the material speedily dulls the edge, and constant resharpening of the tool is necessary. This occasioned much delay, when the old method of cutting pearl buttons was pursued. Moreover, the employment of highly skilled workmen to keep the tools properly sharpened was required."

It followed therefore, that the suspension of the process while the tool was automatically sharpened, was not an isolated operation but a link in the chain of unbroken continuity which made the machine a continuous operative combination leading to a unitary product. In Burdett v. Elevator Co., 196 Fed. Rep. 43, affirmed in 197 Fed. Rep. 743, Judge McPherson said:

"The successive operation of the signals and of the motor is not a decisive objection * * * nor need all its movements be simultaneous. The test is whether there is a new unitary result to the production of which the different elements co-act."

These cases were but following the earlier and leading case in this Court, where in the National Cash Register Co. v. American Cash Register Co., 53 Fed. Rep. 367, this Court made the test the fact that each of the elements there involved

"by the co-operation of the others, capacitated to contribute, by acting in its own peculiar way, to the common end, which, without the co-operation of each and every other of the co-ordinated elements, it would be powerless to accomplish or advance."

This principle was further accentuated by this Court in Novelty Glass Manfg. Co. v. Brookfield, 170 Fed. Rep. 948, where the machine for pressing glass insulators involved several successive steps, namely, (1) the gathering boy poured the molten glass into the machine mould; (2) the presser man brought the mould under the actuating rod, by a lever brought down the screw plunger, detached it and left it seated in the molten glass; (3) by the mechanical revolution of the table, the mould passed to another workman, who by a rotary spindle unscrewed the plunger; (4) by another rotation of the table the mould passed to a fourth workman who opened the same, took out the completed machine moulded insulator. All of these operations were themselves old mechanical processes, but no one had ever combined them to produce a machine-made insulator. But even in view of the fact that all the steps were separately old and were thus in a measure isolated and unconnected, the Court held there was a novel combination and use in a machine which produced a new unitary article, to-wit, a machine-made insulator, in that regard saying:

"It is said, however, that the machine is a mere aggregation, the different parts of which are brought together having no combined action, but simply operating in juxtaposition, each by itself as a complete and independent piece of mechanism, under the manual control of separate workmen. And this view is confirmed, as it is urged, by the way the claims are progressively built up, starting out with a certain number of elements and adding one at each step, even the stop or detent to lock the table, and the standard about which it turns, being utilized to that end. But whatever may be said of the attempt so made, of which more anon, the different parts in our judgment sufficiently co-operate to a common end to dispel

any such idea. The test is whether there is a new unitary result, to the production of which the different elements co-act (Bliss v. Reed, 106 Fed. 314, 45 C. C. A. 304; National Tube Co. v. Aiken (C. C. A. 163 Fed. 264) which certainly is the case. The purpose of the mechanism which is brought together is to make glass insulators, and this it most suc-essfully and expedititously does, a completed article being produced at a single turn. No doubt there are different steps in the operation to which the different parts are successively addressed. But it is not necessary that the insulators shall be made at a single stroke, in which each of the parts shall be involved. That may be desirable, and through the genius of some one, if the nature of the material permits, may possibly be attained. But for the present, a machine which embodies and is adapted to carry out the process, as it is understood and supposedly has to be performed, in which there are distinct parts for the several steps, is not to be condemned as an aggregation on that account."

To our mind, none of these cases,—the interjection of the tool sharpener in the cutting of the pearl button lathe, a mechanical interruption and segregation of the cutting process, but still one essential in the wear and tear of a tool cutter against the hardness of pearl; the signal and motor of the elevator; the successive and distinct stages of the glass insulator machine mould,—present as clear a case of co-acting, combining elements as the present one, the gist of which is the rapid rotation of the core and its resultant radial stretch acted upon by the self-adjusting, spinning rolls. To our mind, the combination in the present case is more marked because in it there is no isolation of stages, but related continuity of action in rapid rotation and co-ordinated roll spinning, to produce the unitary result. As soon as rapid rotation begins, roll spinning also begins and utilizes the rapid rotation to enable the rolls to plaster an unpuckered, radially distended diamond shaped fabric upon the core. To our mind, there could be no clearer and more distinctive characteristic example of combination afforded as the basis for a true combination claim, than is evidenced by the present machine. While in no sense were the elements of rapid rotation, varied stretch of fabric at different zones, spinning rolls and centrifugal force, as an abstract principle, new in themselves, we are satisfied that the utilization of centrifugal force to stretch the fabric and the action of the spinning rolls upon a centrifugally, automatically stretched fabric, was an entirely new combination which State brought into the tire art.

As we have said before, State's was the first successful machine in this country to make a double stretched automobile tire by machinery. It is contended, however, that what he did was anticipated by the Belgian Patent No. 194,731, granted September 20, 1906, to Alphonse Matherne, for a machine and process for mechanically manufacturing casings for pneumatic tires. Without entering into minute details, it suffices to say that by certain mechanism Matherne proposed to unwind the fabric which is advanced to the core, and to stick or plaster it to the tread circumference, or, as the patent

states, "as the fabric is pulled along and unwound from the drum 18 it encounters the rollers 30 on the casing 28 * * * each of these rods carries at its extremity a roller 30 which advances and retracts on the core, so as to stick to its straight or convex sides the fabric which has been placed there." In addition to thus plastering the tread portion and thereby lengthening the fabric along the line of the median circumference of the core, the outer or free edges of the fabric were lessened in length by a process of crimping, which is described in the patent as follows:

"The fabric on leaving the drum passes between two rolls that are spherical or oval in form and arranged in such a manner as to produce a slight lengthening of the middle of the fabric, which lengthening greatly facilitates the removal of the puckers. On the same support there is mounted at each side, two conical gears 36, the sole purpose of which is to produce a slight, uniform puckering of the fabric strips at their edges, ensuring in advance a uniform contraction of the fabric at all points."

Now it will be observed that at this stage, while there is lengthening of the median line of the fabric by circumferentially stretching, there is no contraction of the outer edges by radial stretching. It is true, the edge of the fabric has been crimped or puckered, but this puckering, while it has shortened the line by forming puckers, has not changed the square of the fabric into a radial diamond-shaped interstice, as is the case in State's machine. Moreover, this puckered edge or skirt was not left free as in State, but was plastered down by Matherine to the side of the core, in that regard the patent saying:

"The fabric is placed on the core, which is coated with a layer of rubber solution so that the fabric adheres well to it and may be pulled along by its rotary movement".

To smooth out the designedly formed puckers or wrinkles on the cemented edge of the fabric, Matherne provides a forked tool which has a rounded roller set at an angle on a sliding tool carrier. The operation is thus described:

"On the support 17, which constitutes a tool carrier there is mounted a tool like that shown in Fig. 6 which has a fork with a rounded roller set at an angle. The sliding tool carrier 17 is adjusted so that the roller comes to the level of the top of the core. Then the machine is set in operation and the roller is caused to descend progressively on the side of the core and all the way down to its base. Thus there is obtained the complete and rapid removal from the fabric of the puckers, the descending motion being produced automatically by the pawl 34. Both sides may be readily worked at the same time, by mounting two tools like that shown in Fig. 6, on the sliding tool carrier 17. * * * This last device (the tool of Fig. 6) has a great advantage in being manually controlled, whereby it has the capacity of easily passing over the beads."

We cannot accede to the contention that Matherne's disclosure had the effect of destroying State's practically operated and highly suc-

cessful machine. There is no evidence that the machine in the form disclosed by Matherne had any effect on the art. In point of fact, he suffered the patent to lapse in default of the first payment required after its issue, and when he subsequently obtained a German patent he abandoned his rollers and adopted another form of mechanism. But wholly apart from these considerations, we feel that Martherne did not touch upon or solve the problem overcome by State. In the first place, he deliberately formed puckers and then sought to eliminate them, a procedure wholly different from State, who never formed puckers, and indeed prevented their formation by radial stretch and radial diamond pointed interstices. Matherne plastered his puckers to the core without stretch, and thereafter sought to roll out the puckers. State, on the other hand, left the skirts of his fabric free, and stretched those fabric edges into radial diamond-shaped interstices by the use of high-speed core rotation. Indeed, the whole process of Matherne, so far as the side and inside or bead zone of the fabric was concerned, was simply the use of a hand roller to iron out the puckers he had deliberately formed and plastered on the core. Had the art stopped with Matherne's proposed machine, the auto tire art would not have had the impetus brought about by State's disclosure.

Seeing then, that State's contribution to the tire-making machine art was novel and useful, that it passed into general use and that its worth and the validity of his patent have been acquiesced in by large numbers of manufacturers in the automobile industry, who naturally would not pay tribute unless they were satisfied of the validity of his patent, we turn to the question whether such a meritorious patent is to be invalided as held by the Court below, on account of the disclaimer State filed after the decision in the Sixth Circuit. We cannot give the disclaimer that effect.

Experience has shown that very often applicants for patents, impressed by the seeming importance of their own inventions, have made statements and claims which time and closer knowledge of the art show are unwarranted. In relief of such common mistakes, the disclaimer statutes allow a patentee to seasonably avow such unwarranted statements and unjustified claims, and to restrict and narrow his application to the limits of the real, novel, disclosure he made, and to confine his claims to that limit. Where a disclaimer is filed in good faith, and no attempt is made thereby to broaden or make more inclusive the original disclosure or claims, the law looks with favor on such procedure. In this case, there is no element of fraud, bad faith or an attempt to broaden the disclosure or claims, but an honest effort to eliminate from the specification and the construction of the claims all elements save those which constituted the true disclosure State gave the art.

Broadly speaking, the essence of State's invention consisted of the combination of a power-driven core, with spinning rolls mounted on a radial, moving support, the rolls being so laterally spring-pressed as to compel them to follow the lessening contour of the shoe down to the bead edge. The Court of Appeals of the Sixth Circuit had held

that it was an aggregation to claim a tread roll in combination with the spinning rolls, and the disclaimer withdrew all claims embodying the tread roll, namely, 8, 9, 10, 11 and 14, and also claims 15, 16 and 17, which related to other subsidiary features not connected with those features which make up the essence of the patent. All of these claims disappeared from the patent and are not involved in this case, and such a course of procedure has the warrant of judicial approval: O'Reilly v. Morse, 15 Howard, 62; Sessions vs. Romadka, 145 U. S. 41.

As to the claims which are here in suit and which embody the essential elements of State's disclosure, there was no abandonment of them but simply an assertion of and emphasis upon those vital elements which we have indicated. For example, take claim 22*, which embodies the elements of, first, a power-driven ring core; second, a radially moving support laterally power-pressed toward the core; and third, a spinning roll mounted on a support for passing radially along the sides of the tire-shoe, to shape the sheet of fabric on the core. The effect of the disclaimer is to restrict the operation of these elements to that part of the ring core beyond the tread portion. In that respect, the disclaimer states that in respect to Claim 22,

"I hereby disclaim any combination of the recited elements except when constructed and co-ordinated for shaping and applying a previously unshaped sheet fabric strip to that part of the recited ring-core beyond the tread portion, and unless the power-drive for the ring-core functions by a sufficiently high speed of rotation and consequent centrifugal force to throw the unapplied fabric portion out from the side of the ring-core, while the recited spinning roll in its radial movement and while pressed toward the ring-core, functions by a gradual action upon such centrifugally thrown-out fabric to shape it to the side of the rotating ring-core while bringing it into adhesive contact therewith."

The question of infringement is confined to a narrow limit. The essential elements of State's machine are found in the defendant's machine. We have the rapid rotation of the core. We have the loose edges, stretched by the centrifugal force induced by rapid core rotation. We have a radially moving tool support, and those tools laterally power-pressed not by the spring of State's machine, but by a weight which functions in the same way to bring the spinning rolls into one continuous shifting play, and the whole machine devised to adapt and combine in the same mechanical way State disclosed, the use of spinning rolls, co-operating with centrifugal radial stretch of the fabric to produce the unitary machine-made product, which State first made possible in the art.

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*"22. An open tire-shoe making machine comprising the combination of a sheet-fabric supply, a power-driven ring-core, a radially moving support laterally power-pressed toward the core, and a spinning roll mounted on the support for passing radially along the sides of the tire-shoe to shape the sheeted fabric on the core, substantially as described."

We are, therefore, of opinion the Court below committed error in the entry of its decree, that its decree should be vacated, and the case remanded with instructions to enter a decree finding the claims here involved valid and infringed, and directing an accounting.

Dissenting Opinion.

[Filed Oct. 19, 1922.]

Davis, *Circuit Judge,* dissenting:

I regret that I am constrained to dissent from the conclusions of my colleagues. The Circuit Court of Appeals for the Sixth Circuit found that the patent in question disclosed a mere aggregation and not a patentable combination. Firestone Tire & Rubber Co. v. Seiberling, 257 Fed., 74. In view of the fact that Seiberling really presented his case on the theory that State discovered a new method of making tire casings or a new set of functions to be performed by associated mechanism, the court did not rest its decision upon invalidity, based upon aggregation, but held that he had nothing "broadly new either in his method or in his selected tools." Thereupon Seiberling, the assignee, filed a disclaimer in which he stated that he had reason to believe that through inadvertence, accident or mistake the specification and claims of the letters patent were in part too broad, including that of which State was not the first inventor, but what reason he had or what the inadvertence, accident or mistake was, or which of these, that caused the patentee to claim more than that of which he was the first inventor, he does not state.

Claim 22 which may be used as typical is for a "tire-shoe making machine comprising in combination": 1. A sheet-fabric supply; 2. A power-driven ring core; 3. A radially moving support laterally power pressed toward the core; and 4. A spinning roll mounted on the support at a receding angle to the plane of the core for passing radially along the sides of the tire-shoe to shape the sheet fabric on the core. The claim is for a machine pure and simple. The purpose of the patent was to do by machine what had before been done by hand, and for such a machine a patent may be granted. Conroy v. Penn Electrical & Manufacturing Co., 159 Fed., 943. The function of the elements is stated but there is not a word in any claim of the patent about the method of operation of any element. Seiberling disclaimed entirely claims 8, 9, 10, 11, 14, 15, 16 and 17, on the ground that they contained that of which State was not the first inventor. Claim 8, for instance, contained a machine comprising: 1. A sheet fabric supply; 2. A power-driven ring-core; 3. A radially movable tread-forming roll for shaping the outer portion of the tire; 4. A radially moving support laterally spring-pressed against the core; and 5. A spinning roll mounted on the support to pass radially along the sides of the tire-shoe to shape the sheeted fabric on the core. In this claim which is admittedly too broad and contains that of which State was not the first inventor, there are the identical elements com-

prising claims 4 and 22, which represent the two groups of claims of the patent. In other words, the claims unqualifiedly disclaimed contain the substance of those not disclaimed. Seiberling has put himself in the inconsistent position of disclaiming in one claim the identical thing which he claims in another on the ground that State did not invent the former but did invent the latter. Again, the part retained is not "definitely distinguishable from the parts claimed without right." They are the same thing.

The elements remaining after the disclaimer was filed are not only a new combination but they are invested with a distinct method of operation not claimed in the old combination. This method of operation, prescribed by the disclaimer, is a distinct addition to the claims, expressly made to avoid the effect of the opinion of the Circuit Court of Appeals of the Sixth Circuit and the disclosures of the Belgian patent (first discovered by the patentee during this litigation) No. 194,731, issued to Matherne November 20, 1906. Seiberling disclaimed any "combination of the recited elements except when constructed and co-ordinated for shaping and applying the previously unshaped sheet fabric strip and unless the power-drive for the ring-core functions by a sufficiently high speed of rotation and consequent centrifugal force to throw the unapplied fabric portion out from the side of the ring-core, while the recited spinning-roll in its radial movement and while pressed toward the ring-core, functions by a gradual action upon such centrifugally thrown out fabric to shape it to the side of the rotating core." He thus tried to avoid the conclusion that his machine was a mere "aggregation" and endeavored to reconstruct and co-ordinate the elements of the new combination so as to have them co-act and conjointly produce the result claimed for the machine. The effect of the disclaimer is to retain in part the machine patent and add to it a method of operation. To this extent the character of the patent is changed to a method patent. The disclaimer is a virtual restatement of the claims changing their character from a simple machine to a new combination machine whose elements operate according to a prescribed method. This may not be done by a disclaimer. Enameled Metals Co. v. Western Conduit Co., et al., 269 Fed., 620; Hailes v. Albany Stove Co., 123 U. S., 582, 587. If claims may be changed so that a combination of elements constituting a simple machine may be modified and formed into a new combination and the elements given a prescribed mode of operation by a disclaimer, it is difficult to know what function a reissue performs. This suit may not be maintained by virtue of Section 4922 of the Revised Statutes. The disclaimer invalidates the patent and the decree dismissing the bill, in my opinion, should be affirmed.

[File endorsement omitted.]

In the United States Circuit Court of Appeals for the Third Circuit, October Term, 1922.

No. 2862 (List No. 55).

[Title omitted.]

Decree.

[Filed Oct. 19, 1922.]

Appeal from the District Court of the United States for the District of New Jersey.

This cause came on to be heard on the transcript of record from the District Court of the United States, for the District of New Jersey and was argued by counsel.

On consideration whereof, it is now here ordered, adjudged and decreed by this Court, that the decree of the said District Court in this cause be, and the same is hereby vacated, and the case remanded with instructions to the said District Court to enter a new decree holding the claims here involved valid and infringed, and directing an accounting and the issuance of an injunction. Victor B. Woolley, Circuit Judge. Philadelphia, October 19, 1922.

[File endorsement omitted.]

[Title omitted.]

Received & filed Nov. 16, 1922. Saunders Lewis, Jr., Clerk.

United States Circuit Court of Appeals for the Third Circuit.

[Title omitted.]

Petition for Rehearing.

[Filed Nov. 16, 1922.]

The John E. Thropp's Sons Company, defendant-appellee, respectfully petitions this Court for a re-argument of the above case, decided October 19th, 1922, and assigns as reasons therefor the following:

I.

That in the opinion of this Court, it is held that the dominating feature of the invention of the patent in suit consists in rotating the core at such high speed that centrifugal force, generated thereby, acts upon the outflying edges of the fabric to automatically stretch

the same radially and contract them circumferentially. This feature is frequently referred to in the opinion as, for instance, on page 10, where it is said:

"But here he [State] changed to something the old hand process had never used, namely, the machine was speeded up to a point where the revolution of the wheel [core] and flying skirt of the uncemented loose fabric stretched itself radially and formed thereby radial diamond-shaped interstices, which contracted the normal length of the fabric."

and on page 9 this Court said:

"the crux and dominating functional feature of State's machine is the use upon the fabric of a centrifugal force caused by rapid rotation, a process which is wholly different from the original hand process,"

and again on the same page:

"there is a gradual and uniform, and indeed an unbroken spiral sequence caused by the rapid rotation of the core and the consequent exercise of centrifugal force on the covering material, by which it is automatically gradually stretched radially."

and on page 16:

"we are satisfied that the utilization of centrifugal force to stretch the fabric and the action of the spinning rolls upon a centrifugally, automatically stretched fabric, was an entirely new combination which State brought into the tire art."

and on page 18:

"State, on the other hand, left the skirts of his fabric free, and stretched those fabric edges into radial diamond-shaped interstices, by the use of high-speed core rotation."

With respect, it is submitted that there is no evidence in the record to support this basic holding and, for this reason, we have felt fully justified in attaching to this Petition affidavits of the professors of mechanical engineering at the University of Pennsylvania, Columbia University, and Stevens Institute of Technology, in order to demonstrate to this Court the fact that the above recited holdings are based upon a misinterpretation of the action of centrifugal force as established by the laws of physics. If this understanding of the Court to the effect that centrifugal force automatically produces the radial stretch had been based upon evidence in the record, we should not have felt at liberty to resort to the practise of attaching the said affidavits to this Petition; but, as this holding was apparenly based upon what the Court felt was a matter of common knowledge in respect to the physical effect of centrifugal force, it has seemed to us

justifiable to submit these affidavits made by men of unquestioned ability in order to establish that this thought of the Court involves a misapprehension, and to request that, in case the Court still entertain any doubt as to this fact, the cause be remanded to the District Court with directions that the same be reopened for testimony on this point. These affidavits show that this holding of the Court is contrary to said established laws of physics and imputes to centrifugal force a function which it does not and cannot have. The effort of centrifugal force is to stretch the said outflying skirts circumferentially and, in any event, the amount of centrifugal force, at any core speed which is commercially practicable (e. g., 120-130 R. P. M.), is so trivial as to have no actual stretching effect upon the fabric in any direction.

It is not understood that plaintiff-appellant has even contended that centrifugal force per se acts to produce radial stretch and circumferential contraction. The witness Browne did describe the outflying fabric skirts or edges as being, in effect, held out by invisible fingers (Rec. p. 37), but he agreed, on cross-examination, that this was merely a figure of speech (Rec. p. 83).

"A. Of course, the 'invisible fingers' is a figurative expression, and has reference rather to the direction in which the skirts are standing out, than to the actual direction of the centrifugal force."

For this reason, defendant did not put in any evidence to show that centrifugal force actually has no stretching effect and that, if it had, its tendency would be toward circumferential, not radial, stretch.

In this same connection, the opinion of this Court finds that the spinning rolls merely act to apply or cement to the sides of the core the fabric which has been automatically radially stretched by centrifugal force. Thus, it is said in the opinion on page 10, after describing the radial stretch of the fabric skirts or edges by centrifugal force:

"as the [spinning] rolls revolved they engaged and pushed inward and against the sides of the core the stretched flying skirts of the fabric. Thereby he then, and by the wheels, pressed and cemented the radially stretched and therefore puckerless fabric against the lessening sides of the shoe clear down to the bead edge."

And again on the same page, it is said that the springs caused the spinning rolls

"to automatically press the automatically stretched and loose fabric, or skirts, in an unwrinkled state, on the bead of the lower surface of the core."

On page 15, in describing the combination of the patent in suit, the opinion of this Court says:

"the gist of which is the rapid rotation of the core and its resultant radial stretch acted upon by the self-adjusting, spinning rolls."

and again on the same page:

"As soon as rapid rotation begins, roll spinning also begins and utilizes the rapid rotation to enable the rolls to plaster an unpuckered, radially distended diamond shaped fabric upon the core."

On page 18, it is said that State

"never formed puckers, and indeed prevented their formation by radial stretch and radial diamond pointed interstices."

It appears from the annexed affidavits that the centrifugal force does not produce the radial stretch, so that the spinning rolls cannot act to press fabric which has already been automatically radially stretched against the sides of the core. Such radial stretch as takes place is necessarily accomplished by the inward mechanical push of the spinning rolls themselves, and it is understood that this has always been the contention of the plaintiff, the argument being that centrifugal force held the fabric away from the core so that the spinning rolls could get a better grip upon it. There are statements by plaintiff's expert Browne with respect to using enough centrifugal force to bring about radial stretch, but they are always accompanied by words to the effect that the radial stretch is produced by the inwardly moving spinning rolls.

The fact that the fabric which the spinning rolls press against the core is not one which has been automatically radially stretched so as to eliminate the formation of puckers is fully shown by Plaintiff's Exhibit 35, photographs of State machines, which are reproduced on pages 189, 191 of Volume II of the Record. In these pictures, particularly photograph No. 2 on page 191, are shown an abundance of puckers in the unattached fabric, and it is admitted by plaintiff's witness Trogner that this photograph No. 2 shows a condition in which the spinning rolls have just about completed their inward radial movement on the outer layer of fabric (Rec. p. 626, Q. 28). This photograph shows not only the outer layer, but two or three inner layers, the spinning operations upon which have necessarily been completed, and which plainly embody a multitude of puckers or wrinkles. The operation of laying down the remainder of the puckered or wrinkled fabric is performed by hand (Rec. p. 234, line 30). This situation is well explained in the uncontradicted testimony of defendant's expert Waterman as to the operations of these machines which he witnessed at the Goodyear plant where the commercial machines were exhibited to him by plaintiff's counsel and expert (Rec. p. 230, Q. 16). Mr. Waterman said, at the bottom of page 233:

"In practically every layer of fabric applied very large and very bad wrinkles were formed and it was necessary to stop the machine and lift up the fabric and smooth it down by hand with a spade, after having applied cement underneath in some instances."

As the exhibit photographs above referred to were presented by plaintiff, and as the exhibition of the commercial Goodyear machines was given to defendant's expert for the purpose of his testimony in this case, it may be assumed that the photographs and exhibition represented plaintiff's case in the best light. Therefore, the unquestioned fact of the presence of abundant wrinkles or puckers in the fabric after the high speed rotation and even after the operation of the spinning rolls, conclusively shows that the centrifugal force does not radially stretch the fabric so as to contract its circumferential length and bring it into the proper form to smoothly fit the core, as well as that the spinning rolls certainly have something more to do than merely to cement or attach an automatically, centrifugally, radially stretched fabric to the core. A comparison of the said exhibit photographs of the Goodyear machines with photographs Nos. 10 and 11 comprising part of Defendant's Exhibit D, photographs of the operation of the Belgian machine, shows that the conditions are essentially the same.

It may be added, with emphasis, that the patent nowhere suggests any radial stretch as being produced by centrifugal force, and this although the application for patent was not filed until a year and a half after State claims to have developed the Goodyear commercial machine.

If it be conceded that centrifugal force does not automatically, radially stretch the fabric as repeatedly set forth in the Opinion: then there is nothing to distinguish the asserted invention of State from the Belgian patent or the prior hand spinning.

II.

The decision of this Court bases the novelty of the invention upon a high speed rotation of the core, which is not a structural feature, and is so indefinite that no line can be drawn between infringement and non-infringement. Defendant cannot tell, nor can any one else tell, how fast it can rotate the core without infringing. The same machine might be infringing at ten o'clock in the morning and non-infringing at eleven o'clock, according to variations in the speed of the drive, or variations in the size of cores placed thereon, since, even at the same speed, centrifugal force varies with the diameter of the core. Such indefiniteness of claims renders them void under the Statute. Minerals v. Butte, 250 U. S. 336. As said by the Court in Bullock v. General, 149 F. R. 409, 417:

"Or suppose the artisan wishes to construct a ventilated armature, and does not care to use Reist's separators, how shall he know in what manner he shall avoid the Reist patent? How thin must his separators be to do this? Or suppose a purchaser wishes to buy one. He must look out for the patent. By what test or comparison shall he be guided? These inquiries enforce the rule that the patentee must describe with sufficient certainty the particulars of his invention so that the artisan and the public may know the char-

acter and limits of it, and how it is to be distinguished from others which the one may make, or the other purchase, in safety."

The only speed of core rotation mentioned in the patent is 207 R. P. M. (Pat. p. 2, line 4), and this is impractical and far higher than anything used by plaintiff or defendant in commercial operations (Rec. p. 231, p. 271, bottom, p. 41).

III.

Although the defense of joint invention was not referred to in the Opinion, it is assumed that the same was considered by the Court and overruled, so that we do not discuss that question here or argue any of the other matters which were embodied in the briefs originally submitted, but simply base this Petition upon the respectful submission that the Court has fallen into a manifest error with respect to the action of centrifugal force, which error controls the decision of the case.

Your Petitioner believes that this Honorable Court erred in the points above named, and, as the decision sustaining the patent was based thereupon, it

Therefore prays that a rehearing may be had on the said points and that a time may be set therefor; and that the issuance of the Mandate herein be stayed pending a decision on this Petition.

Your Petitioner also moves that, if this Court entertains any doubt as to the fact with respect to the effect of centrifugal force, this case be remanded to the District Court with direction to reopen the same for the taking of proofs on this point. The John E. Thropp's Sons Company, By Peter D. Thropp, Vice-President. E. Clarkson Seward, Thomas G. Haight, Counsel for Petitioner.

State of New York,
County of New York, ss:

Peter D. Thropp, being duly sworn on oath, says:

That he is Vice President of The John E. Thropp's Sons Company, the defendant-appellee and petitioner herein; that he has read the foregoing petition and knows the contents thereof; that the matters therein stated are true, so far as such matters are within the knowledge of deponent, and as to all other matters therein stated, the same are true to the best of deponent's information and belief.

That the reason why this verification is not made by the petitioner in person is that the said petitioner is a corporation. Peter D. Thropp.

Subscribed and sworn to before me this 16th day of November, nineteen hundred and twenty-two. F. George Barry, Notary Public, Westchester Co., N. Y. (Seal.) Certificate filed in New York Co.

We hereby certify that the foregoing petition for a rehearing is, in our opinion, well founded in point of law, and is not interposed for

purposes of delay. E. Clarkson Seward, Thomas G. Haight, Counsel for Petitioner.

In the United States Circuit Court of Appeals for the Third Circuit.

No. 2862.

Frank A. Seiberling, Plaintiff-Appellant.

v.

The John E. Thropp's Sons Company, Defendant-Appellee.

Affidavit.

State of Pennsylvania,
County of Philadelphia, ss:

William H. Kavanaugh, being duly sworn, deposes and says as follows:

I am professor of experimental engineering at the University of Pennsylvania, and have held this position for about six years. Previous to coming to the University of Pennsylvania, I was for nine years professor of experimental engineering and head of that department at the University of Minnesota.

The opinion of his Honor, Judge Buffington, in the above entitled case, has been called to my attention, particularly with respect to the holdings as to the effect of centrifugal force upon the edges of the tire fabric which are outflying from the core, and I have been asked to state whether or not centrifugal force acts as recited in the opinion, particularly with reference to that portion where it is stated:

"But here he changed to something the old hand process had never used, namely, the machine was speeded up to a point where the revolution of the wheel and flying skirt of the uncemented loose fabric stretched itself radially and formed thereby radial, diamond-shaped interstices, which contracted the normal length of the fabric."

In preparing myself to answer this question, I have carefully read the opinion, and have spent an entire day in a tire factory observing the operation of one of the defendant's tire making machines. In this machine, the fabric is stretched onto the tread portion of the core while the latter is rotated at a speed of 13 RPM, and is spun down on the sides of the core while it is rotated at 130 RPM, by spinning rollers which move radially with respect to the core and are laterally pressed toward the same by weights. I have very carefully examined the operations and the effect upon the fabric with respect to circumferential and radial stretch.

It is a fact that centrifugal force, which is generated during the rotation of the core at high speed, does not act in such a direction as to even tend to produce radial stretch in the outflying edges or skirts of the fabric. On the contrary, the fact is that the tendency of centrifugal force is to circumferentially stretch the said edges of the

fabric. This is because each of the said outflying edges is in the form of a cylindrical, endless band, which band centrifugal force tends to make larger during the rotation at high speed of the core. Thus, if the centrifugal force were powerful enough to produce any stretch, it would be a circumferential stretch which would tend to make the interstices of the fabric diamond-shaped with the long axes circumferentially disposed, and to increase the circumferential length of the fabric instead of contracting it. The foregoing are physical facts which require no inspection of the operation of making tires to establish. Furthermore, the amount of centrifugal force which is generated as a result of rotating a core adapted for making a tire about 35 x $4\frac{1}{2}$ in size at 130 RPM is insignificant and utterly impotent to produce any stretch in the outflying skirts of the fabric. It actually amounts, in a tire of the size stated, to approximately 0.168 ounces for each square inch of fabric in the flying skirt. The circumferential stress or pull developed in the skirt by this centrifugal force is only 2.562 ounces per inch of the skirt width. I have made tensile tests of this fabric which show that a stress or pull of this amount stretched or elongated the fabric less than $\frac{1}{8}$ of 1 per cent; which is a negligible amount, and which is, moreover, against radial stretch.

I state with complete confidence that any radial stretching which may be produced in the manufacture of tires as described, is the result of mechanical action of the spinning rollers, and is in no way accomplished by centrifugal force, since, as already stated, the latter acts in an opposite direction and could not possibly produce a radial stretch and circumferential contraction, either or both. There is no analogy between the endless band which constitutes the outflying edge of the fabric, and a strip or ribbon of fabric which might be secured to the core and permitted to fly out radially therefrom. Aside from well-known considerations, this may be illustrated by the fact that, before the fabric edges could ever get into such outflying radial position, they would have to be circumferentially stretched 20.1 inches in a tire of the size mentioned above. This would require that the fabric be stretched about 20 per cent.

I am compelled to state, with the greatest respect, that the numerous references in the opinion of his Honor, Judge Bullington, to the radial stretching effect of centrifugal force, necessarily imply a misinterpretation of the physical force at work, since its action is the opposite of that recited in the opinion.

Subscribed and sworn to before me this — day of November, nineteen hundred and twenty-two.

United States Circuit Court of Appeals for the Third Circuit.

No. 2862.

Frank A. Seiberling, Plaintiff-Appellant,

v.

The John E. Thropp's Sons Company, Defendant-Appellee.

Affidavit.

State of New York,
County of New York, ss:

George B. Pegram, being duly sworn, deposes and says as follows:

I am Professor of Physics in Columbia University where I have been on the staff of the Department of Physics for twenty years, the past eight years as Professor of Physics. I am also dean of the engineering school of Columbia University. I have been teaching the subject of mechanics for twenty years.

I have read the opinion of his Honor, Judge Buffington, in the above entitled case and have read also parts of the Record on Final Hearing, Volume II, Exhibits, and parts of the Brief for Plaintiff-Appellant. In the opinion in this case statements are made as to the part played by centrifugal force in the operation of the plaintiff's tire making machine, which statements assign to centrifugal force the role of radially stretching by distortion of the mesh and thereby circumferentially contracting the loose fabric or skirt prior to its being pressed down and caused to stick to the form by the action of the forming wheels or rollers. I refer particularly to the following portions of the opinion:

Page 9:

"there is a gradual and uniform, and indeed an unbroken spiral sequence caused by the rapid rotation of the core and the consequent exercise of centrifugal force on the covering material, by which it is automatically gradually stretched radially."

Page 10:

"But here he changed to something the old hand process had never used, namely, the machine was speeded up to a point where the revolution of the wheel and flying skirt of the uncemented loose fabric stretched itself radially and formed thereby radial, diamond-shaped interstices, which contracted the normal length of the fabric."

"as the rolls revolved they engaged and pushed inward and against the sides of the core the stretched flying skirts of the fabric. Thereby he then, and by the wheels, pressed and cemented the radially stretched and therefore puckerless fabric against the lessening sides of the shoe clear down to the bead edge."

Page 15:

"the gist of which is the rapid rotation of the core and its resultant radial stretch acted upon by the self-adjusting, spinning rolls."

Page 16:

"we are satisfied that the ultilization of centrifugal force to stretch the fabric and the action of the spinning rolls upon a centrifugally, automatically stretched fabric, was an entirely, new combination which State brought into the tire art."

The problem of finding the exact form which a mesh fabric of threads which are by no means inelastic, such as that applied in the making of tires, will assume under the action of centrifugal and other forces is not a simple one, but I can say definitely that in the operation of the plaintiff's tire making machine centrifugal force cannot act in such a way as to change the shape of the meshes of the fabric skirt by "radially" elongating them and "circumferentially" shortening them. The first effect produced by centrifugal force on the loose skirt is to smooth out the ruffle by causing the skirt to assume the form of a surface of revolution. Thereafter the centrifugal force tends to pull all parts of the loose fabric farther away from the axis of rotation. Let us imagine circumferential stripes marked on the flying skirt or band of the fabric. Any one of these stripes is, of course, being urged away from the axis of rotation by centrifugal force, but if it is to move farther away from the axis the stripe must be lengthened circumferentially. Circumferential lengthening by distortion of the mesh is necessarily accompanied, however, by radial shortening of the mesh. If the flying skirt, attached at its inner edge, were in the plane of rotation, it is obvious that the motion of any stripe away from the axis would result at one and the same time in circumferential elongation of the mesh and in radial elongation of the mesh; but this simultaneous stretch in both directions is impossible of attainment by simple distortion of the mesh. Consequently in this case centrifugal force could produce no distortion. In the actual case, however, the flying skirt or band of the fabric forms a surface which is far from lying in the plane of rotation, being at the beginning of the spinning operation approximately a cylinder perpendicular to the plane of rotation. In this case a stripe of the material could move under the action of centrifugal force farther away from the axis by circumferential lengthening and corresponding radial shortening of the mesh, provided the band tilted up toward the plane of rotation, since this change of angle would enable the band of fabric as a whole and in every part to get farther away from the axis of rotation without having to increase in width and even while undergoing a decrease in width corresponding to the required circumferential elongation.

Thus the primary and necessary condition for any yielding of the band to centrifugal force is a circumferential stretch, which stretch if due to mesh distortion is just as necessarily accompanied by "radial" contraction. With all respect, I am compelled to state

that the effect of centrifugal force in distorting the mesh of the band of fabric would therefore be the opposite of that stated in the opinion.

I may say further that it does not appear to me that the centrifugal force at such speeds as are used by the plaintiff would be great enough to produce any appreciable distortion of the mesh of this rather firm fabric. At a speed of 120 revolutions per minute and a radius of 18 inches the centrifugal force on any part of the fabric would be only about seven times its weight. George B. Pegram.

Sworn to and subscribed before me this 16th day of November, nineteen hundred and twenty-two. Charles S. Danielson, Notary Public, Westchester County. (Seal.) Certificate, New York County No. 91, New York Register No. 3090. Term expires March 30, 1923.

United States Circuit Court of Appeals for the Third Circuit.

No. 2862.

FRANK A. SEIBERLING, Plaintiff-Appellant,

v.

THE JOHN E. THROPP'S SONS COMPANY, Defendant-Appellee.

Affidavit.

STATE OF NEW JERSEY,
County of Hudson, ss:

Robert M. Anderson, being duly sworn, deposes and says:

I am professor in charge of mechanical engineering at the Stevens Institute of Technology, and have held this position for three years. For the past ten years I have also been professor of engineering practise at the same place.

I have been consulted with respect to the opinion of his Honor, Judge Buffington, in the above matter, and particularly with respect to that part of the opinion in which he says:

"But here he changed to something the old hand process had never used, namely, the machine was speeded up to a point where the revolution of the wheel and flying skirt of the uncemented loose fabric stretched itself radially and formed thereby radial, diamond-shaped interstices, which contracted the normal length of the fabric."

I understand that, in manufacturing automobile tire casings of woven fabric, a strip which is cut on the bias and impregnated with rubber, is circumferentially stretched about the iron core so as to cause it to conform to and adhere to the outer or tread portion thereof; and that this is done while the core is rotated at comparatively low speed, such as 12 or 13 RPM. This circumferential stretching of the fabric naturally changes the square meshes thereof into diamond shaped meshes on the outer periphery of the tire, which have their long axes circumferentially disposed. I under-

stand that the unattached edges of this fabric strip are smaller in circumference than the outer periphery of the core.

Following this procedure, I understand that the speed of the rotation of the core is increased to 120 or 130 RPM., so that the edges of the fabric fly out and take a position substantially at right angles to the plane of the core, and that the said edges of the fabric are then smoothed down on the sides of the core by spinning rolls which are moved inwardly in a radial direction while pressed towards the sides of the core.

I gather from the opinion of his Honor, Judge Buffington, and, specifically, from the passage above quoted, that he believes the effect of centrifugal force during high speed rotation of the core is to stretch the side edges of the fabric radially and change the meshes of these parts of the fabric into diamond shapes with the long axes radial, thereby contracting the length or circumference of the edges of the fabric.

With respect, I must say that this involves misinterpretation of the action of centrifugal force, since the action thereof on the free outflying edges of the fabric would tend to enlarge the circumference of the same and thereby bring about circumferential stretch. In other words, if the centrifugal force generated is enough to have any stretching effect upon the fabric, it will be to stretch the same circumferentially and change the square meshes to diamonds with the long axes circumferential, instead of imparting a radial stretch and contracting the length or circumference of the fabric. This is based upon established facts in physics about which there is no question. I may add that the effect of centrifugal force upon these endless bands constituting the free edges of the fabric, is not at all the same as its effect would be upon a ribbon or strip of fabric secured to the core and permitted to fly out radially in the plane of the core or parallel thereto. The side edges of the tire fabric cannot fly out into any position in the plane of or parallel to the plane of the core without being circumferentially stretched to a very decided extent.

With great respect, I am positive in the assertion that, under the conditions of tire manufacturing described, centrifugal force can have no tendency to cause the fabric to stretch itself radially and thereby form radial diamond shaped interstices which contract the normal length of the fabric, as stated by his Honor, Judge Buffington. Robert M. Anderson.

Subscribed and sworn to before me this 16th day of November, nineteen hundred and twenty-two. Adolph H. Geigir, Notary Public, N. J. (Seal.)

United States Circuit Court of Appeals for the Third Circuit.

[Title omitted.]

Memorandum by Plaintiff-Appellant in Opposition to Petition for Rehearing.

[Filed Dec. 1, 1922.]

Plaintiff-appellant opposes the petition by defendant-appellee for re-argument on the ground that the point advanced is not only without proper foundation but also immaterial.

Lack of Foundation.

The entire matter is based on isolated and incomplete portions of the opinion, quoted without their context, and with emphasis so stressed as to give them a strained and unintended meaning. Petitioner in substance alleges that these passages indicate that the Court ascribes the stretching and shaping of the fabric skirts to centrifugal force alone, and held this to be "the dominating feature," and that, therefore, its finding is based on a misapprehension of the invention. Both the premise and conclusion are without foundation. Petitioner does not deny the new result which State accomplished,—obviously it cannot do so,—but says the Court found it due solely to the centrifugal effect. In opposition to this, respondent contends the Court's real finding to be that the shaping and stretching of the fabric and its application to the core are due to the action of all the elements, "all conjointly functioning to produce a unitary machine result which neither of them separately could effect." This language occurs in a passage from the Court's opinion which is in full as follows:

"It will therefore be seen that the *essence of his disclosure* was the rapid, sustained, regular revolution of his core, the use of a shifting platform on which he located his spinning rolls, and the constant, regular and uniform exertion of pressure upon those spinning rolls, causing them to automatically press the automatically stretched and loose fabric, or skirts, in an unwrinkled state, on the bead of the lower surface of the core. *If this statement of the process be correct, and there can be no doubt in that regard*, it follows that the process is a unitary one, is a continuous one, is an interrelated one, is an undivided one, and that there is a continuity of uniform, sustained, progressive, advance from the start to the finish of this machine-made tire, which is brought about by the rapid revolution of the core wheel acted upon by the spin of spring-controlled engaging rolls cooperating with the centrifugal force generated by the rapid motion of the core. In other words, united, cooperating, *conjoint functioning of the core speed and spinning rolls*, effected by roll springs and the shift of roll platform, all conjointly

functioning to produce a unitary machine result which neither of them separately could effect." (Italics ours.)

This was the first specific statement of the Court's position, and it is difficult to see that it could be more explicitly expressed. When the matter was again referred to at later points, and apparently to avoid prolixity, an ab reviated statement was employed, and it is upon these later references that petitioner's contention is based. Had petitioner desired to find them, there are several other precise statements of the cooperative functioning involved, as for instance the following:

"To our mind, the combination in the present case is more marked because in it there is no isolation of stages, but *related continuity of action in rapid rotation and co-ordinated roll spinning, to produce the unitary result.* As soon as rapid rotation begins, roll spinning also begins and utilizes the rapid rotation to enable the rolls to plaster an unpuckered, radially distended diamond shaped fabric upon the core. To our mind, there could be no clearer and more distinctive characteristic example of combination afforded as the basis for a true combination claim, than is evidenced by the present machine." (Italics ours.)

Could anything be clearer that to the mind of the Court the valuable feature was the cooperation of the several distinct elements?

Everywhere the basic finding of the Court is that the State invention involved a true combination:

"Each element acts and has to co-act with its fellows to produce the unitary result and make the unitary product which alone the machine was fashioned and devised to produce."

And again, in referring to previously litigated instances of combination, the Court says that none of them

"present as clear a case of co-acting, combining elements as the present one, *the gist of which* is the rapid rotation of the core and its resultant radial stretch acted upon by the self-adjusting, spinning rolls." (Italics ours.)

And there is much more to the same effect. In the face of positive statements of this character, how is petitioner justified in contending that the Court reached its conclusion by attributing the principal result to centrifugal force alone?

Moreover, the Court's finding in sustaining the State patent is in accord with the language of the disclaimer quoted in the opinion, which similarly sets forth the co-operation of the high speed core and its centrifugal effect with the radially moving spinning roll:

"* * * and unless the power-drive for the ringcore functions by a sufficiently high speed of rotation and consequent centrifugal force to throw the unapplied fabric portion out from the side of the ring-core, while the recited spinning roll in its radial movement and while pressed toward the ring-core, functions by a gradual

action upon such centrifugally thrown-out fabric to shape it to the side of the rotating ring-core while bringing it into adhesive contact therewith."

There is no support anywhere in the opinion for petitioner's contention that State's result of attaching a radially stretched fabric to the core arises from anything other than the combination under discussion, except in the brief phrases quoted, and then only when taken without reference to context and often in mutilated form.

Immateriality.

On the point of immateriality, respondent contends that if the State combination functions to produce the indicated result, and that is not denied, the precise mode of elemental cooperation is immaterial. It is not necessary to apportion the exact amount of result proceeding from the action of each of the elements of the combination, i. e., whether or not the radial stretch is effected entirely by centrifugal force, or entirely by the advancing spinning roll, or partly by centrifugal force and partly by the spinning roll, or in what proportions by centrifugal force and by the spinning roll. It is sufficient to note that the resulting effect is secured by the cooperation of the several elements, each of which 'acts and has to co-act with its fellows to produce the unitary result," as stated by the Court again and again in one form or another.

In making its case, respondent (plaintiff) attributed the stretching effect to the conjoint action of centrifugal force and advancing spinning roll along the lines indicated by the disclaimer, its working theory being that centrifugal force throws out the skirt of the fabric in unwrinkled condition and under tension, the resistance being sufficient to produce radial stretch as the roll advances, but there was no effort to apportion the merit for the resultant between the parts.

There is in addition a distinct line of analogous authorities, both in the Supreme Court and in this Court, to the effect that a statement of complete mode of action is unnecessary. For instance:

Eames v. Andrews, 122 U. S. 40 (55):

"An inventor may be ignorant of the scientific principle, or he may think he knows it and yet be uncertain, or he may be confident as to what it is, and others may think differently. All this is immaterial, if by the specification the thing to be done is so set forth that it can be reproduced."

Diamond Rubber Co. v. Consolidated Rubber Co., 220 U. S. 428. See particularly page 435 and the cases cited;

Note also the cases in this circuit:

Westmoreland Co. v. Hogan, 167 Fed. 327 (328);
Mead-Morrison Co. v. Exeter Works, 225 Fed. 489 (496);
Gear v. Fairmount Co., 231 Fed. 728 (732);
Searchlight Co. v. Victor Co., 261 Fed. 395 (400).

The Affidavits.

Petitioner has filed several affidavits by college professors of physics, etc. Quite a part from the question of propriety in employing them in a proceeding of this nature, such affidavits serve to emphasize the necessity for careful scrutiny, when experts have their eyes directed only to a single feature and blinded as to others. Cross-examination would have speedily developed the importance of the cooperation and conjoint functioning of the several elements, but apparently all this was religiously kept from the affiants. Respectfully submitted, Robert Fletcher Rogers, Counsel for Plaintiff-Appellant.

In the United States Circuit Court of Appeals for the Third Circuit, March Term, 1922.

No. 2862 (List No. 55).

[Title omitted.]

Sur Petition for Rehearing.

Order Denying Petition for Rehearing.

[Filed Dec. 4, 1922.]

And now, to wit December 4, 1922, after due consideration, the petition for rehearing in the above-entitled case is hereby refused. Per Curiam. Philadelphia, December 4, 1922.

[File endorsement omitted.]

Clerk's Certificate.

United States of America,
Eastern District of Pennsylvania,
Third Judicial Circuit, sct:

I, Saunders Lewis, Jr., Clerk of the United States Circuit Court of Appeals, for the Third Circuit, do hereby Certify the foregoing to be a true and faithful copy of the original record Vol. I and proceedings in this Court in the case of: Frank A. Seiberling, Appellant, vs. John E. Thropp's Sons Co., Appellee, No. 2862, on file and now remaining among the records of the said Court, in my office.

In testimony whereof, I have hereunto subscribed my name and affixed the seal of the said Court, at Philadelphia, this seventh Day of December in the year of our Lord one thousand nine hundred and twenty-two and of the Independence of the United States the one hundred and forty-seventh. Saunders Lewis, Jr., Clerk of the U. S. Circuit Court of Appeals, Third Circuit. [Seal of the United States Circuit Court of Appeals, Third Circuit.]

[File endorsement omitted.]

Clerk's Certificate.

UNITED STATES OF AMERICA,
Eastern District of Pennsylvania,
Third Judicial Circuit, set:

I, Saunders Lewis, Jr., Clerk of the United States Circuit Court of Appeals, for the Third Circuit, do hereby Certify the foregoing to be a true and faithful copy of the original Volume II (Exhibits) of the Transcript of Record as filed in this Court in the case of: Frank A. Seiberling, Appellant, vs. John E. Thropp's Sons Co., Appellee, No. 2862, on file, and now remaining among the records of the said Court, in my office.

In testimony whereof, I have hereunto subscribed my name and affixed the seal of the said Court, at Philadelphia, this seventh Day of December in the year of our Lord one thousand nine hundred and twenty-two and of the Independence of the United States the one hundred and forty-seventh. Saunders Lewis, Jr., Clerk of the U. S. Circuit Court of Appeals, Third Circuit. [Seal of the United States Circuit Court of Appeals, Third Circuit.]

Writ of Certiorari and Return.

[Filed Nov. 20, 1923.]

UNITED STATES OF AMERICA, *ss:*

[Seal of the Supreme Court of the United States.]

The President of the United States of America to the Honorable the Judges of the United States Circuit Court of Appeals for the Third Circuit, Greeting:

Being informed that there is now pending before you a suit in which Frank A. Seiberling is appellant, and The John E. Thropp's Sons Company is appellee, No. 2862, which suit was removed into the said Circuit Court of Appeals by virtue of an appeal from the District Court of the United States for the District of New Jersey, and we, being willing for certain reasons that the said cause and the record and proceedings therein should be certified by the said Circuit Court of Appeals and removed into the Supreme Court of the United States, Do hereby command you that you send without delay to the said Supreme Court, as aforesaid, the record and proceedings in said cause, so that the said Supreme Court may act thereon as of right and according to law ought to be done.

Witness the Honorable William H. Taft, Chief Justice of the United States, the twelfth day of March, in the year of our Lord one thousand nine hundred and twenty-three. Wm. R. Stansbury, Clerk of the Supreme Court of the United States.

[File endorsement omitted.]

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United States Circuit Court of Appeals for the Third Circuit.

[Title omitted.]

Stipulation.

It is stipulated by Counsel for the respective parties that the Transcript of record and Proceedings filed in the United States Supreme Court on Petition for Certiorari herein may be taken as and constitute the return by the Circuit Court of Appeals for the Third Circuit to the Writ of Certiorari directed to said Circuit Court of Appeals by the United States Supreme Court, under the date of March 12, 1923. Rogers, Kennedy & Campbell, Solicitors for Plaintiff-Appellant. E. Clarkson Seward, Solicitor for Defendant-Appellee. March 15, 1923.

United States of America,
Eastern District of Pennsylvania,
Third Judicial Circuit, sct:

I, Saunders Lewis, Jr., Clerk of the United States Circuit Court of Appeals, for the Third Circuit, do hereby Certify the foregoing to be a true and faithful copy of the original stipulation of counsel to be used as return to the writ of certiorari in the case of: Frank A. Seiberling, Plaintiff-Appellant, vs. The John E. Thropp's Sons Co., Defendant-Appellee, No. 2862, on file and now remaining among the records of the said Court, in my office.

In testimony whereof, I have hereunto subscribed my name and affixed the seal of the said Court, at Philadelphia, this nineteenth Day of March in the year of our Lord one thousand nine hundred and twenty-three and of the Independence of the United States the one hundred and forty-seventh. Saunders Lewis, Jr., Clerk of the U. S. Circuit Court of Appeals, Third Circuit. [Seal of the United States Circuit Court of Appeals, Third Circuit.]

[File endorsement omitted.]

(9018)